RADIO AMATEUR NEWS

REG. U.S. PAT. OFF.

15 Cents

NOVEMBER 1919

OVER 100 ILLUSTRATIONS

Edited by H. Gernsback

"The 100% Wireless Magazine"

In This Issue:

AUDIO FREQUENCY WIRELESS TELEPHONE
By Edward T. Jones, A. M. I. R. E.

THE THREE ELECTRODE THERMIONIC VACUUM TUBE. By Prof. W. H. Eccles

SECOND RADIO PRIZE CONTEST AWARD

A 170-25000 METER RECEPTOR FOR ALL TYPES OF RADIO COMMUNICATION
By Francis R. Pray

PUBLISHED BY EXPERIMENTER PUBLISHING CO., 233 FULTON ST., N. Y. C.

"ASK ANYONE WHO HAS USED IT"

SAID DENVER COL., TO VALLEY STREAM, L. I.:—

One of our most enthusiastic customers communicates by wireless from his home in Denver to a friend on Long Island. He uses a Brandes Headset—after exhaustive tests and comparisons. (Name on request)

BRANDES WIRELESS HEADSET

"Superior" Set—2000 ohms, $7.

CLEAR TONE

LIGHT WEIGHT

DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by

"BRANDES MATCHED TONE"—

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER

Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare it with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

SEND 4c FOR CATALOGUE "G"

C. BRANDES, Inc., Room 823 32 Union Square, New York, U. S. A.

WIRELESS RECEIVER SPECIALISTS

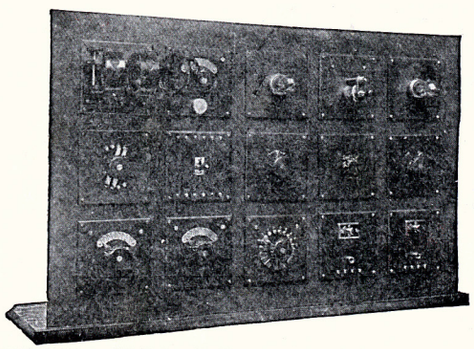
PICTURE below shows typical 15-panel DE FOREST Unit Receiving Set consisting of a Tuner with wave length range of 150 to 25,000 meters; a crystal and an audion detector, and a one-step amplifier. This Set is the most complete and efficient receiving apparatus ever put out under $150.00. Its cost is considerably less than that, the entire set of Units shown below totaling only $133.57.

DE FOREST Unit Receiving Set

Gives You Better Apparatus at Low Cost

The DE FOREST Unit Receiving Set offers the only practical system of securing accurately designed, highly efficient receiving apparatus without paying for expensive factory assembly and costly cabinets. You buy the individual units and assemble them yourself, thus becoming more expert.

You can start with a few, inexpensive Units which will give you a Receiving Set of an efficient but simple type, and then build up, always fitting new Units into the system as additions to the old. No junking of old apparatus; just add to them to increase your selectivity and circuit efficiency as new developments come out.



If you are thinking of taking up wireless work, find out about the DE FOREST Unit Receiving Set before you get your apparatus. It will give you the most highly developed Radio instruments obtainable. And if you are an Amateur, Student or Experimenter, this Unit Set holds even greater possibilities for you because in using your own ingenuity in assembling the Units you will greatly broaden your Radio knowledge.

SEND FOR THE DE FOREST CATALOGUE R. A. GIVING COMPLETE DESCRIPTIONS

A 64-page book of Radio Apparatus which illustrates and describes many other interesting features.

Sent postpaid for 10 cents.

De Forest Radio Telephone and Telegraph Co.

Inventors and Manufacturers of Amateur and Commercial Radio Apparatus

1415 SEDGWICK AVENUE, NEW YORK CITY

AMPLIFY YOUR RADIO SIGNALS

ONE of the greatest drawbacks since the invention of wireless telegraphy is the receiving of weak signals at the receiving station. Many devices were proposed to improve this condition, but without success, on account of the mechanical difficulties encountered in these amplifying devices.

However, this was recently solved by the introduction of an exceedingly sensitive microphone transmitter, which is known to detect sound waves with great accuracy and magnify them through an intermediate telephone circuit.

By the employment of the new DETECTAGRAPH-TRANSMITTER, the amateur can amplify the radio signals to such an intensity that he can hear the signals about his station without the need of the telephone head set.

By the addition of a loud talking telephone he is able to hear the messages many feet away from the instrument. He is also able to demonstrate the operation of his wireless apparatus to his friends.

The super-sensitive DETECTAGRAPH-TRANSMITTER herewith shown is two and three-eighths inches in diameter, five-eighths of an inch thick and weighs less than three ounces. It is the most sensitive sound detecting device ever brought before the public.

SUPER-SENSITIVE **Detectagraph** MICROPHONE DEVICES

Practical Instruments for Commercial and Scientific Purposes.

Our Super-Sensitive Detectagraph Transmitter. Price, $8.00 Complete

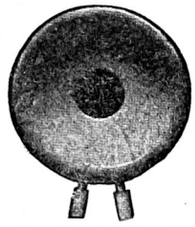
The manner in which the amplifying process is attained is by attaching with tape the DETECTAGRAPH - TRANSMITTER to the regular wireless receiver as indicated in the diagram.

Other Uses

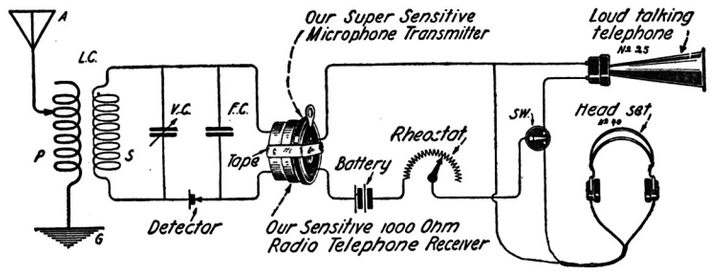
Not only is this instrument applicable for amplifying radio signals, but it can be used with equal satisfaction for magnifying other sounds. Phonograph music can be transmitted from one place to another by means of this instrument, and those who are afflicted with deafness will find enormous benefit by using this transmitter.

It is the greatest device for building your own loud talking telephone, detectagraph and other devices. Can be used for any purpose where a sensitive detecting instrument is required.

Adjusted Model "B" Horn with Loud Talking Receiver, No. 20. Cord Plugs and Desk Stand Base Price $15.00 Complete.



Our Special No. 25 Loud Talking Receiver Price, $4.50 Complete



Adjusted Model "C" Horn, with Loud Talking Wall Receiver No. 20. Price

$15.00 Complete

DETECTAGRAPHS

FOR THE EXPERIMENTER FOR DETECTIVES FOR THE DEAF

DETECTAGRAPH

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

$18.00 Complete

DETECTAGRAPH JUNIOR DEAF-PHONE

The outfit consists of a Super-Sensitive Transmitter, with a cord connector; Super-Sensitive Ear Piece with small black cord; Black Single Headband; Black Case and two small Batteries. Transmitter 2⅜ inches in diameter, ⅝ of an inch thick, and weighs less than three ounces.

$18.00 Complete

Detectagraph Rheostat, especially made for amplifying circuits.

Complete **$2.00**

Super Sensitive No. 40 Receivers to be used in connection with Detectagraph Transmitters.

$10.50

Order direct from ad. Or write for free descriptive circular. For your convenience use the coupon.

G. Boissonnault Co., 25 Church St., N. Y. C.

As per your ad in Radio Amateur News, please send me free circulars and full particulars about your Detectagraph Devices.

NAME .....

ADDRESS .....

CITY .....

STATE .....

G. BOISSONNAULT COMPANY

25 CHURCH STREET NEW YORK CITY

Makers of Super-Sensitive Microphone Devices

RADIO AMATEUR NEWS

CONTENTS

FOR NOVEMBER

PAGE

"Our Freedom of the Ether" By H. Gernsback, Editor 213

"Audio Frequency Wireless Telephone" By E. T. Jones 214

"The Eaton Oscillator and Eaton Circuit Driver" ..... By William H. Priess 216

"Why I Am Opposed to Government Radio Control" By Dr. Greenleaf W. Pickard 218

"Why I Am Opposed to Government Radio Control," By Dr. Lee de Forest 218

"Underwater Submarine Telegraphy" 218

"Developing an Audion for the Amateur" By E. T. Jones 219

"A 170-25000 Meter Receptor" By Francis R. Pray 221

"Second Prize Award—Radio Contest" 222

"Amateur Radio Broadcast de Navy Department 223

"The Radio Constructor" 224

"Notes on R-34 Return Trip" By R. F. Durrant, Lieut. R. A. F. 225

"San Diego, Cal., from London" By Alexis J. Hall 227

PAGE

"How Manufacturers Work 'Formica' and 'Bakelite'" ..... By J. Stanley Brown 228

"Ideas—2nd Spasm," By Thos. W. Benson 230

"Increasing the Secondary Voltage of Your Transformer," By F. E. Terman 231

"Notes on Crystal Detectors" By C. H. Byron 231

"Your 'Fist'" ..... By C. H. Pfeifer 232

"Radio Digest" 234

"With the Amateurs" 235

"Local Forecast—Stormy" By Dorothy Kantro 236

"The Third Pill" ..... By J. K. Henney 237

"Club Gossip" 238

"Junior Radio Course" By W. A. Heppner, Associate Editor 240

"New Radio Patents" 242

"I Want to Know" 243

"A True Hard Luck Story" By Herbert Richter 250

"Destruction of the Brussells Station in 1914" ..... By Henry M. de Gallaix 220

RADIO AMATEUR NEWS is publisht on the 25th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $1.50 a year in U. S and possessions. Canada and foreign countries, $2.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 15 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you should change your address notify us promptly, in order that copies be not miscarried or lost. **A red wrapper indicates expiration. No copies sent after expiration.**

All communications and contributions to this journal should be addressed to: Editor, RADIO AMATEUR NEWS, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on puolication. A special rate is paid for novel experiments: good photographs accompanying them are highly desirable.

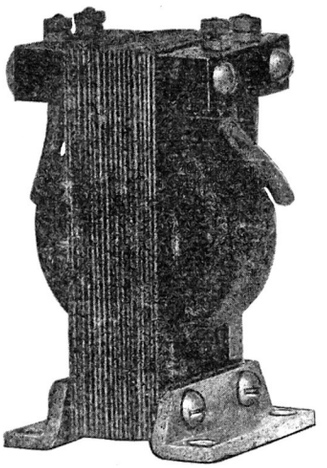
RADIO AMATEUR NEWS. Monthly. Entered as second-class matter June 6th, 1919, at the Post Office at New York, N. Y., under the Act of March 3, 1897. Title registered U. S. Patent Office. Copyright, 1919, by E. P. Co., Inc., New York. The Experimenter Publishing Co., 233 Fulton Street, N. Y., N. Y. **The Contents of this magaizne are copyrighted and must not be reproduced without giving full credit to the publication.**

RADIO AMATEUR NEWS is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.

H. GERNSBACK, President. S. GERNSBACK, Treasurer. R. W. DEMOTT, Secretary.

AUDIO FREQUENCY TRANSFORMER

TYPE P



PRICE $7.00
Postpaid

IMMEDIATE DELIVERY

Standard Vacuum Tubes $7.00 each.

Due to its operation on the principle of voltage amplification through resonance this transformer provides a maximum of low frequency amplification and is superior to all others.

Permits reliable daylight reception from European stations.

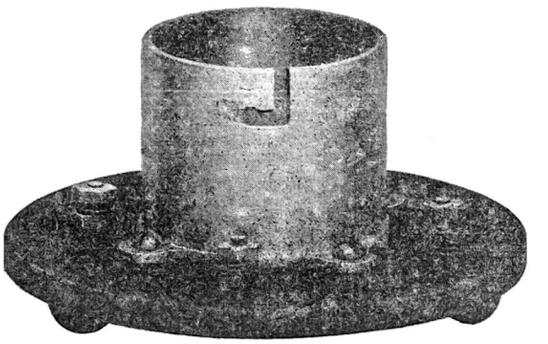
Establishes new amateur long distance records.

Renders remarkable amplification of all signals.

May be used with the Marconi and all standard tubes.

VACUUM TUBE SOCKET

TYPE TRIODE F



Price $1.25 Postpaid

The base of this socket is bakelite dilecto and will not crack and break like the moulded material of the usual socket. Contact springs are stamped with identifying letters. Base is provided with three rubber feet and four countersunk holes for panel mounting.

We also manufacture:

Eaton Oscillators — Two Step Amplifiers
Grid Leaks — Damped and Undamped Receivers

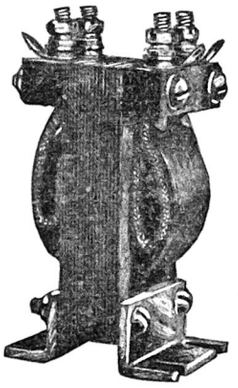
FARADON MICA TRANSMITTING CONDENSERS

Standard and Special Radio Equipment of every description.

WIRELESS SPECIALTY APPARATUS Co.,

ENGINEERS, DESIGNERS, MANUFACTURERS
BOSTON, MASS, U. S. A.

Federal Audio-Frequency Transformers



No. 226-W
Type A
PRICE
$7.10 Each

For Use with Marconi V. T. Class I and II are Pronounced Unexcelled by Experts.

Especially Efficient for One or Two Stage Amplification — and Regenerative Circuits—

All Amateurs, Laboratories, Schools and Experimenters who wish to obtain the best results should have this transformer.

WRITE FOR BULLETIN No. 102-W

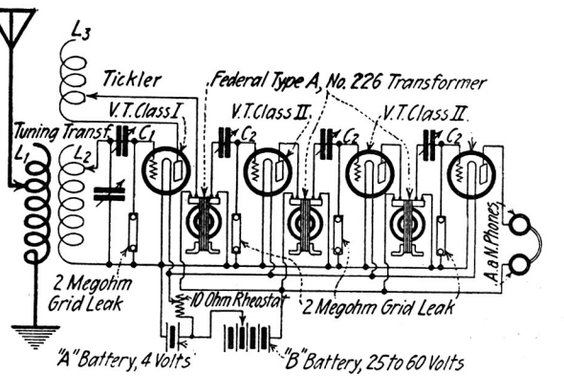


Fig. 3. Regenerative Circuit with Three-Stage Amplifier

FEDERAL TELEPHONE AND TELEGRAPH CO.

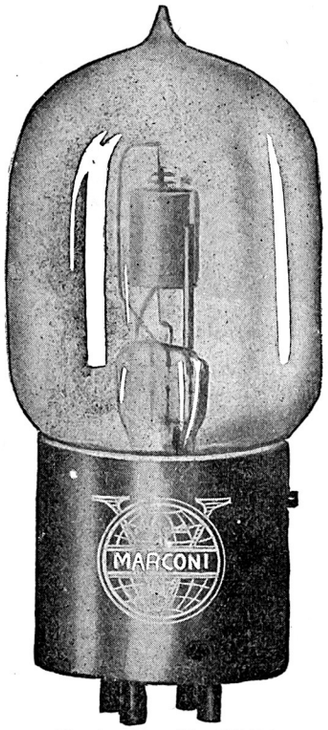
BUFFALO, N. Y.

Distributors for Marconi Vacuum Tubes—Standard Sockets and Leak Resistances

MANUFACTURERS OF

Standard Air Core Audio Transformers—Navy Type "Liberty" Head Telephones.
Famous "Century" High Frequency Buzzers—Anti-Capacity Switches.
Standard Jacks, Plugs and Accessories.

THE HEART OF THE WIRELESS



Fleming Pat. No. 803684
De Forest Pat. Nos. 841387-879532

An Amateur Station Without a Vacuum Tube is Years Behind the Times

MARCONI V.T.

$7.00 each

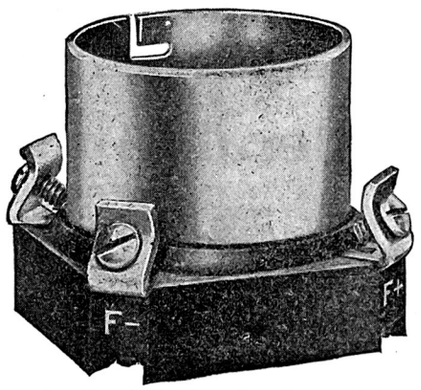
Under agreements recently effected the Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

The approximate operating life of the MARCONI V. T. is 1,500 hours.

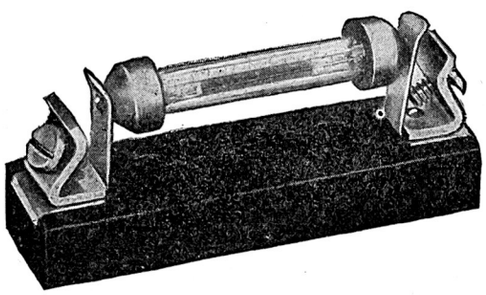
Class I.—Designed for use as a detector; operates with plate potential of 20 to 60 volts.

Class II.—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.



Standardized Socket $1.50 additional



Standard Resistance, Complete $1.00

The Marconi Resistance, connected in the circuit between the grid and the filament of the Marconi V. T., is made in the following standard sizes:

½ megohm, 1 megohm, 2 megohms, 4 megohms, 6 megohms.

Resistances of any special fractional values up to 6 megohms can be supplied.

Send all remittances with order to COMMERCIAL DEPARTMENT

MARCONI WIRELESS TELEGRAPH CO. OF AMERICA 225 BROADWAY, NEW YORK

Retail Office and Exhibition Rooms—25 Elm St., New York

Sole Distributors for De Forest Radio Telephone & Telegraph Co.

BRANCH OFFICES:

Schofield Bldg., Cleveland, Ohio
American Bldg., Baltimore, Md.
Insurance Exch. Bldg., San Francisco, Cal.
136 Federal St., Boston, Mass.
301 Commercial Bank Annex, New Orleans, La.
109 South 2nd St., Philadelphia, Pa.

RADIO AMATEUR NEWS
H. GERNSBACK, EDITOR

Vol. 1. NOVEMBER, 1919 No. 5

Our Freedom of the Ether

AS briefly announced in our October issue, the ether is free once more for transmitting to the American amateur. While the Government has consented towards the lifting of the ban, it should be understood by all that this is at best only a transitory stage. By this we mean that indications point to the fact that it may not be permanent. There are several bills before Congress now, all seeking regulations or modifications of radio, particularly of radio transmission. This, of course, means radio telegraphy as well as radio telephony.

Amateurs should thoroly understand the fact that they have, so to speak, been put upon probation. If they are going to annoy Government and commercial stations or even make themselves felt in such a way that they will only slightly hinder prevailing Government or commercial traffic, it will cut down our dearly won freedom by just so much.

There will come a day when amateurs will not need to bother their heads about Government or commercial stations, but that day has as yet not arrived. The radio millenium is still to come. We mean by this, that with our present form of crude apparatus still in vogue, and when we are only using *quasi* makeshifts, we cannot expect that we can tune our transmitters down to within the hundredth fraction of a meter. Usually the amateur wave is so broad that it can be picked up all over the scale. As long as we persist in sending out such waves we must expect criticism from the big stations with which we interfere.

Amateurs should understand once and for all that they should not use spark coils in connection with the usual stationary spark gap. This gives rise to a broad wave which can never be tuned out because such waves are not sharp. Hence interference on a large scale.

An improvement is found in our rotary spark gap and in our quenched spark gaps, but these are not wholly satisfactory by any means, and at most are still exceedingly crude. The best of the two gaps is, of course, the quenched gap, providing it is built correctly. More often, however, the amateur has neither the knowledge nor the necessary precision machinery to turn out an accurately built quenched gap.

Most amateurs are greatly in favor of using rotary gaps at the present time which, however, leave much to be desired. They are neither efficient nor are they carefully built to give the results which we are after. For one thing the present rotary gap is built entirely too heavy and too clumsy. We have seen gaps using as high as 1/4 of a H. P. to run, which not alone is wasteful in current, but actually does not make for better results. It should be possible to build very light and small gaps that can be worked by the smallest battery motor or by an equally small power. Such gaps can be readily constructed with ball bearings, and the zinc plugs can be spaced much closer together than the practice in vogue now. By speeding up this gap, we should be able to get better results than with the cumbersome large machines we use now. Another improvement that occurs to the writer might be had by using such a small gap and constructing it in such a way that two discs studded with zinc plugs could be run at opposite directions driven with one single motor. This gives twice the speed and should result in a better wave. Other experiments along this line that might be tried are as follows:

By enclosing the rotary gap in a housing, it is possible to pipe it for gas supply, compressed air, etc. Some of these ideas have been tried out abroad with good results, and it is up to the amateur to improve upon them. During the war, the Germans used a certain rotary gap running in a liquid, the nature of which has not been disclosed. Very good results were obtained from this spark gap, and right here is a point worth while working upon. Much good might result from such experiments.

It is, of course, true that a rotor running in a liquid tends to cut down the speed quite a good deal, and it takes also much more power to run such a gap. If we increase the over-all efficiency of the gap, however, this should not cut much figure, at most the power necessary to drive the rotor in liquid should not be more than 50 to 75 per cent. over a rotor running in the air under atmospheric pressure.

So far for wireless telegraphy. We now come to wireless telephony. Here the case is facilitated a great deal, and here we need not be concerned so much that we interfere with commercial or Government stations, for the reason that when we use the audion principle of sending out undamped waves, we immediately use a sharper wave which makes less trouble, besides it is possible with the audion or oscillion arrangements to tune on a comparatively short wave. In other words, here we have not so much trouble in staying within our 200 meters wave length than if we were using our rotary or quenched gaps.

It is to be hoped that amateurs will pay earnest attention to their transmitters during the next few months so that we will have a clean start. Once we have set our house in order, it should be easy for us to keep on improving our stations in such a way that our legislators in Washington will not even have the slightest pretense for criticising amateur stations.

At this point, we wish to pay homage to Representative Greene of Massachusetts, who has constantly championed our cause in Washington. He, more than anyone else, was the man responsible to have our radio stations opened October 1st. If it were not for him, the lid might have been on as yet. Amateurs owe a good deal of thanks to Representative Greene, who not only has championed our cause, but who has done so in an energetic as well as intelligent manner. He is one of the few legislators who know what radio is and what it means to this country, and what its great and unlimited possibilities are.

H. GERNSBACK.

Audio-Frequency Wireless Telephone

By EDWARD T. JONES, A. M. I. R. E.

MR. EARL C. HANSON, an ingenious inventor, who has specialized in audio-frequency currents, is the party responsponsible for the TPS system employed thruout the war for tapping the

Mr. Hanson speaking into the transmitter of his Audio-Frequency Wireless Telephone.

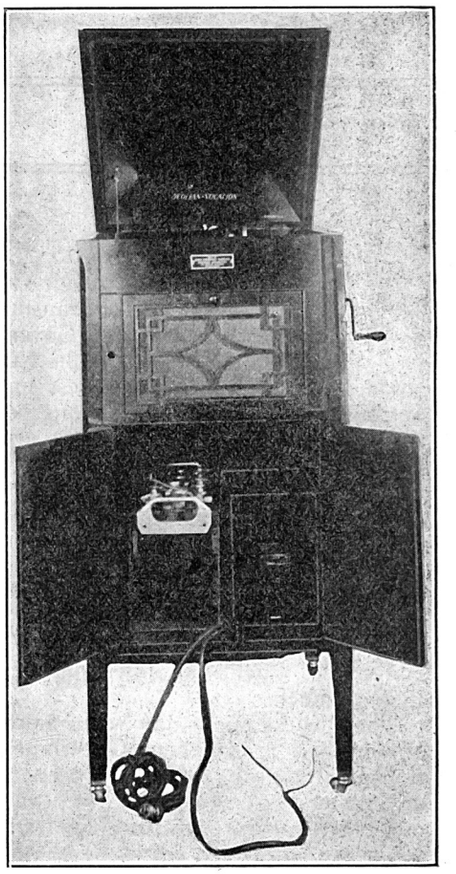
enemy's lines of communication. This system was also installed in and about hospitals; music and phonograph renditions were furnished the wounded inmates. In the photograph is shown a wounded soldier listening to the music produced by a centrally located phonograph, which of course, furnishes the same music to the numerous buildings located on the hospital reservation.

those listening in, or lectures or speeches delivered by simply throwing a switch and the speaker talking directly into the transmitter furnished with the switchboard. A close-up view of the switchboard is shown below. One very interesting feature of this particular apparatus is the method employed to transmit the sounds reproduced from the records by the Aeolian-Vocalion, and which is shown in one of the photographs. Three transmitters are mounted on the reproducer of the phonograph so that each transmitter picks up and sends out faithfully the reproductions from the records. Each transmitter is connected to a separate primary winding of a special audio frequency transformer; the secondary leads go to the antenna and ground proper, respectively. A diagram of the connections employed is shown in Fig. 1.

One remarkable feature of this system is the fact that the party receiving the music or other renditions from the phonograph *can vary the intensity and pitch* of the incoming sounds to suit his taste. This is done by varying the pressure of the hand on the insulated cylindrical metal piece furnished for that purpose. This is shown in Fig. 2, where one connection is made from the metal cylinder to the bed, while the body of the operator is employed as the remaining portion of the circuit, *being electro-statically connected to the bed* thru the thin layer of insulation on the metal cylinder held in the hand. From the foregoing it can be readily seen that increasing or decreasing the pressure upon the cylinder changes the capacity of coupling between the body and the bed, and the resultant sounds produced in the receiver vary accordingly. Besides, as the inventor points out, this adds materially to the pleasure derived from the instrument, as it arouses their curiosity, and provides a very interesting form of amusement for bed-stricken patients of any hospital.

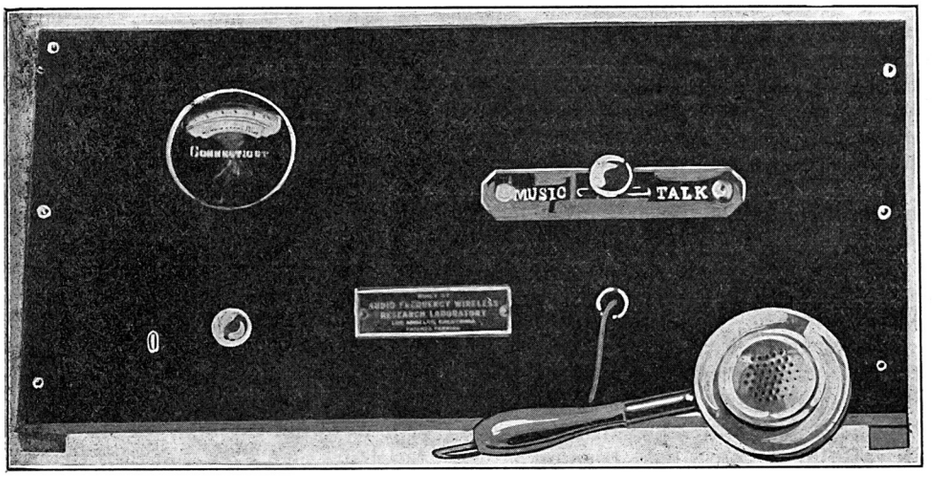
A detector is not required, since we are dealing with audio-frequency currents, and

The importance this last mentioned fact lends to future amateur communication

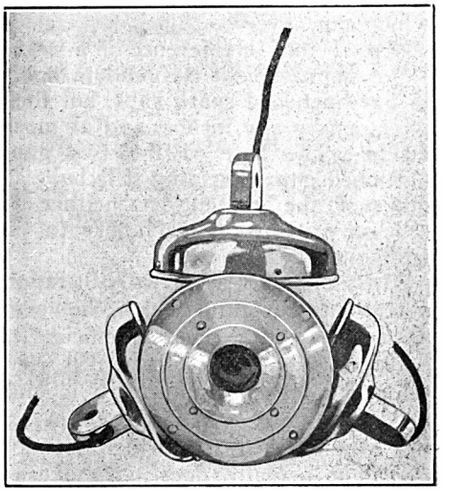


Showing the lower compartment of the Vocalion phonograph

cannot be underestimated. Amateurs in and about a city where a large commercial, Naval or Army station is situated could operate on any wave length possible with this system *without interfering* with said station, due to the fact that audio-frequen-



Arrangement of controls and meter on the panel of the upper compartment. Note the type of transmitter used.

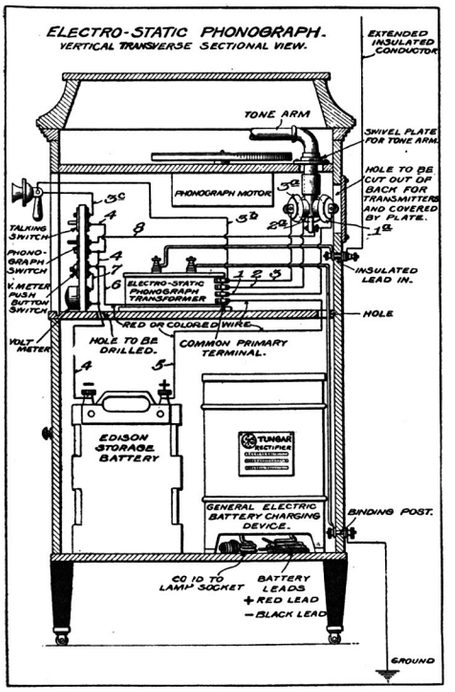


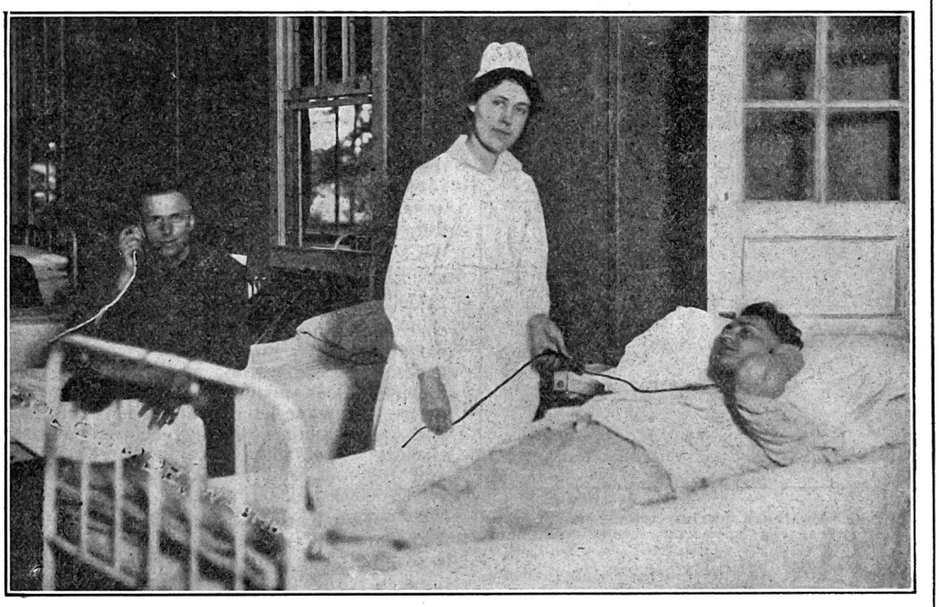
This combination of transmitter mounted on the reproducer assures perfect music at the receiving station.

The entire transmitting apparatus is encased in the Aeolian-Vocalion, as shown in the photograph, and arrangements are provided whereby music can be sent to

if it is desired to increase the strength of the sounds received it is only necessary to connect an amplifier directly into the circuit.

cy currents are being employed to transmit with, and are not picked up by the

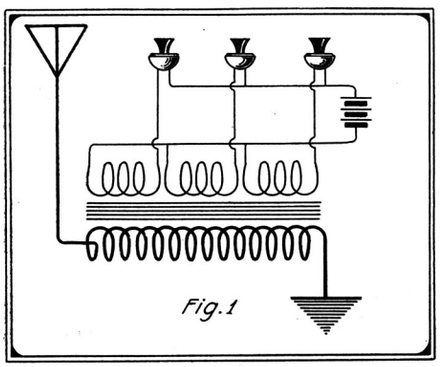




The Diagram on the Left Shows the Detailed Construction Plan and the Connections of the Wireless "Telephonegraph." It is apparent From the Above Photograph That the Wounded Soldiers Enjoy the Music Transmitted by This New Invention.

commercial station employing a detector of any type.

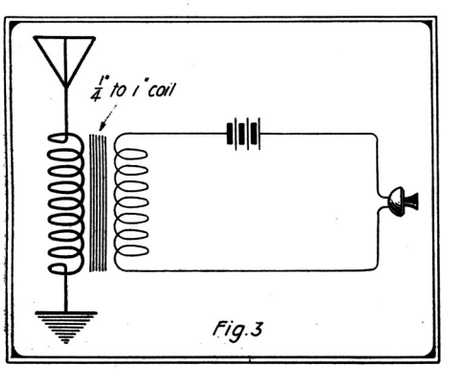
This marvelous and useful instrument as devised by Mr. Hansen, was formally presented to the Walter Reed General Hospital May 20, 1919, in the presence of a few interested persons.



Here Is the Method of Connecting the Three Transmitters in the Circuit.

This invention is but one of the many remarkable things in radio engineering Mr. Hansen has to his credit. He was the first one to talk from an express train to an airplane a considerable distance away.

Mr. Hansen has made numerous other inventions in the radio field, among which have been devices of great aid to aviators.



Showing the Connections for Using the Spark Coil for Transmitting Speech and Music.

CONSTRUCTION OF THE ELECTRO-STATIC WIRELESS TELEPHONE

Now that the apparatus employed in the various hospitals has been described, the construction of a complete set for the amateur will be discussed in detail.

The Transmitter

As Mr. Hansen pointed out in his explanation to the Editors, an ordinary spark coil from one-quarter inch up to one inch, will serve the purpose admirably well. To the primary is connected an ordinary telephone transmitter in series with several dry cells, the number of which best suited for most efficient operation will be found after tests have begun, as coils vary as to their ratios, according to the manufacturer. The secondary of this spark coil is connected directly between the antenna-ground, as shown in Fig. 3.

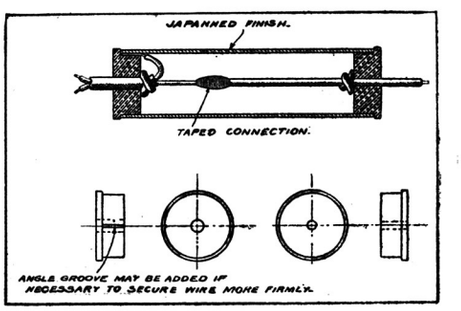
In order to make the set as compact as possible, it will be well for the experimenter to encase the spark coil, batteries and transmitter in a suitable box, well finished and highly stained and polished to improve its appearance. The mouthpiece can be made to protrude out of the box thru a hole cut for that purpose, or it can be mounted on the outside of the container.

The Receiver

When the transmitter and receiver are separated but very few feet, it shall be found that response can be had by connecting an ordinary telephone receiver in series with the antenna and ground circuit, but for distances such as would be required by local amateur work, it will be necessary to employ an amplifier connected directly in the antenna circuit, as shown in Fig. 4. With such an arrangement it will be found that radio frequency oscillations such as emitted by radio stations *cannot be picked up and that the radio stations cannot pick up the voice currents which are being sent out by the above transmitter at audio-frequencies.* This provides a *free* field not enjoyed by the amateurs before.

Amateurs should get busy immediately and construct this type of apparatus for local work, as this may turn out to be the only friend of the amateurs in times of dire necessity; for there could not possibly be a law enacted against the use of audio-frequency apparatus when it does not and cannot interfere with the commercial and Navy radio frequency operated stations.

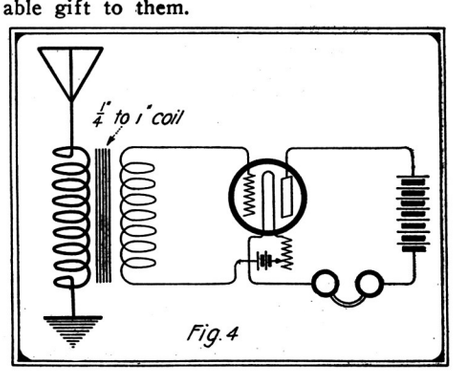
Besides, this thing is in its infancy and it is up to someone in the field at large to send us word before long that great distances are being covered with this system without the slightest interference to local radio stations. Here's the chance to tune your set up to 600 meters and feel confident that you are not going to disturb anyone in so doing.



By Varying the Pressure of the Hand on the Cylinder the Pitch of the Music Is Controlled.

You can give thanks to the RADIO AMATEUR NEWS for bringing this to your attention.

The amateurs are undoubtedly indebted to Mr. Hansen for his ingenious and valuable gift to them.

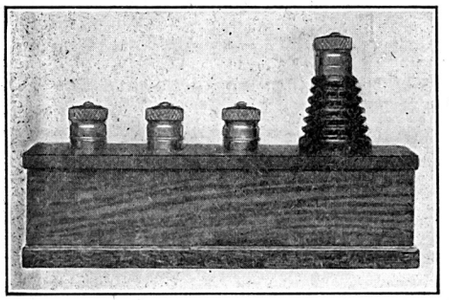


This is the Amplifier Circuit Used in Receiving the Audio-frequency Signals.

The Eaton Oscillator and Eaton Circuit Driver

By WILLIAM H. PRIESS*

One of the earliest devices used for the reception of undampt signals with a vacuum tube was the circuit invented by Lieu-



All you Amateurs having trouble with your C. W. sets will appreciate this instrument.

tenant Eaton of the United States Navy. This system of reception called for the use of a combination of condensers that would cause any initial impulse on an oscillating circuit to be reflected back into the circuit with an amplified amplitude. The additional energy is drawn from a local battery and exactly follows the variations of the initial pulse. Successive development of this circuit has reduced it to a form requiring no adjustments. Eaton units can be connected directly between a tuned circuit and the vacuum tube across the terminals of the condenser in the tuned circuit. They will then serve either as a source of oscillation in the tuned circuit, or, as is common practice, a source of oscillations differing by an audible frequency from an incoming oscillation imprest upon the tuned circuit, and thus permit the reception of signals by the autodyne. These devices are distinctive in their elementary simplicity. They can be directly connected across a wavemeter or any other inductance-capacity combination, and will produce oscillations without any further adjustment of the tuned circuit.

The Eaton Oscillator.

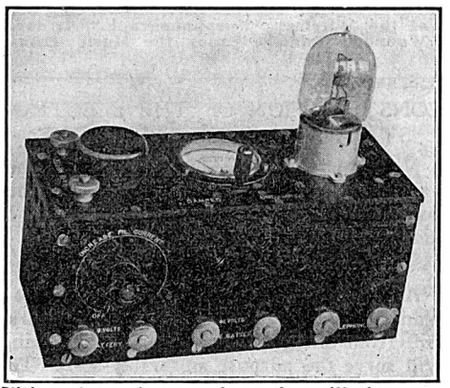
This instrument can be used for the reception of arc, tube, high frequency alternator and other types of undampt stations. A new departure in radio apparatus design is incorporated in this device. A glance at the photograph will clearly show the extreme simplicity of this very ingenious instrument. It consists simply of a small case with posts for connecting the external circuit.

A novel departure in radio practice is incorporated in this design, in that the wiring diagram of the complete external circuit is engraved upon the cover so that no instruction is necessary for its use. The external circuit is engraved in white, the internal circuit in red. On the left-hand side is engraved the oscillating circuit, on the right hand side the tube circuit.

A high insulation resistance between the grid and the ground is provided by a tall corrugated insulator. The complete internal apparatus is thoroly impregnated under vacuum, and sealed in a moisture-proof low dielectric loss insulator. We recommend its use for wave length ranges between 230 and 45,000 meters. It may be used across circuits whose inductance lies between .05 and 100 m.h. and whose capacity lies between .0003 and .005 m.f.

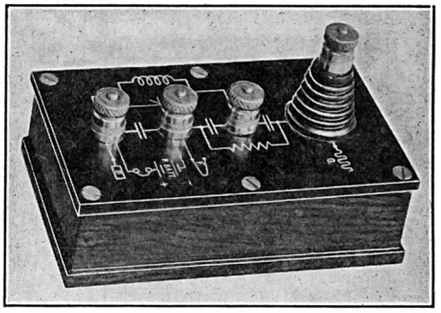
The Eaton Circuit Driver.

Modern practice in radio laboratory work is to employ a source of undampt oscillations for the measurement of resistance,



Either damped or undamped oscillation are generated by this apparatus.

capacity, inductance, and wave length at radio frequencies. In the photograph is shown a device for exciting a driver circuit with either dampt or undampt oscillations for making these measurements. The vacuum tube control consists of an ammeter and 35-point skeleton frame rheostat and



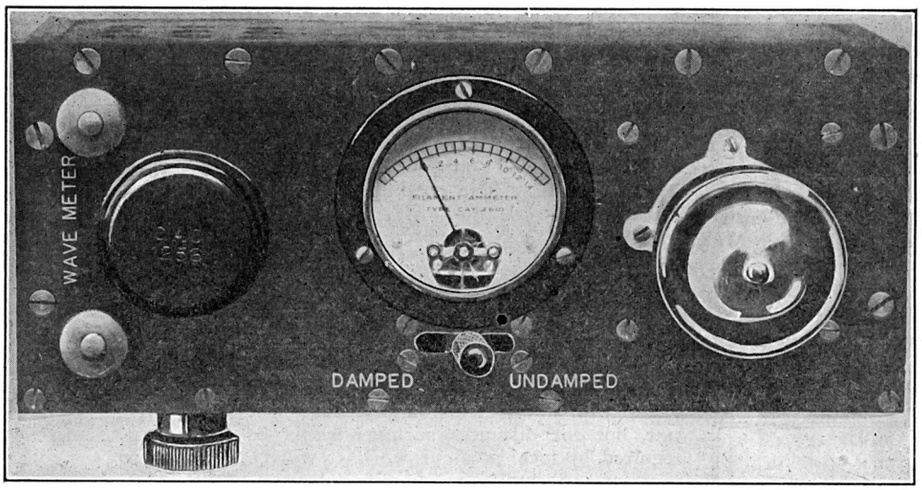
Showing the engraving of the oscillating and tube circuits.

tube socket. An auto transformer is inserted in the plate circuit for choking the high frequency energy from the plate battery. Taps taken off this transformer are led to the telephone binding posts to permit the instrument functioning as a receiver of undampt oscillations as well as circuit driver. The oscillating system is the Eaton circuit, previously described. A key switch throws the circuit from the undampt to the dampt type.

The buzzer used for producing the dampt oscillations gives a high pitched note. The current and the buzzer may be controlled by the same rheostat that controls the filament current of the tube. Two binding posts are provided for the connection of either the wavemeter or the receiver circuit. Binding posts are likewise provided for the filament battery, plate battery and telephones.

The instrument is built on two bakelite dilecto panels which form respectively the side and top of the protective case. An asbestos shield between the rheostat and the remaining circuit and the ventilation provided in the rheostat compartment effectively prevent the flow of heat into the tube circuit and Eaton oscillator compartment. The instrument is mounted on four rubber feet. It provides the most compact form of twin driver that has yet been devised.

Early in 1917 the United States Navy standardized exclusively on the Eaton circuit for its receivers. Its most sensitive receivers at the present time employ the Eaton circuit for producing and controlling oscillations.



This shows the top view of the circuit driver.

Constant Impedance Audibility Meter

By WALTER J. HENRY†

An audibility meter is an essential piece of apparatus in all comparative tests of receivers and telephones, for the reason that it reduces the strength of signals to a definite standard basis of numerical comparison, thus, unit audibility, or an audibility of one, is the strength of a signal which is just audible. By means of a variable shunt around the telephones, we can always reduce the strength of signal to unit audibility. If we knew the proportional cur-

(*Continued on page* 248.)

*Chief Engineer Wireless Specialty Apparatus Co.
†Sales Manager, Wireless Specialty Apparatus Co.

The Three-Electrode Thermionic Vacuum Tube and the Revolution in Wireless Telegraphy

By PROF. W. H. ECCLES, D.Sc., M.I.E.E.

DURING the war dark hints reached the civilian that a revolution was taking place in wireless telegraphy, the principal agent in which was reported to be an instrument called a "valve," a "lamp," or a "tube." This instrument seemed to have risen suddenly into a predominant position among all the apparatus of the wireless experimenter and operator, and appeared to be of use in every corner of his outfit. The complete name of the instrument is the three-electrode thermionic vacuum tube. It must be emphasized that it is the three-electrode valve, and not the valve with two electrodes, that has been responsible for the overthrowing of the old methods and apparatus. That it has been a veritable revolution can be seen by comparing the common practice in wireless telegraphy of 1914 with that of 1919. In 1914 practically all the most powerful transmitting stations in the world generated waves by sparks, and signals were received at nearly all stations by means of crystal detectors or magnetic detectors. The spark method of generating waves involved the use of very large antennæ for spanning great distances; and at receiving stations which wished to listen to stations more than even 100 miles away very large aerial structures were customary. But if we look at the state of affairs to-day we find most of the high-power stations for long-distance transmission are "continuous wave" stations, that is, they produce uniform uninterrupted waves instead of a series of short gushes made by sparks; while at the receiving end new modes of detecting these continuous waves appropriate to, and taking advantage of, their uniformity in character have been introduced. This is where the three-electrode tube, in various adaptations, enters the arena. Taken together, the improvements at both ends of the span have made possible the use of smaller antennæ at transmitting stations, and have almost removed the necessity for any antenna at all at receiving stations. For example, under reasonable weather conditions, it is quite easy to listen to the messages coming from stations on the other side of the Atlantic by using a receiving circuit of which the receptive element is a small coil of wire, three or four feet square. Thus, so far as receiving goes, it is possible to intercept practically all the great stations on one half of the globe by means of apparatus contained wholly in one room, or even in a cupboard. This does not mean that the use of an antenna for reception is abolished; on the contrary, when these highly magnifying methods are put into operation with large antennæ for the purposes of reception, the range over which signals can be received is extended very far beyond what it was in 1913, and, in consequence, it is possible, under reasonably good weather conditions, to receive at the antipodes the signals from a modern high-power station. In accomplishing this the magnifications in use amount to several hundred-thousand-fold. All this is the work of a thing which looks like an ordinary electric light bulb with a few extra pieces of metal in it—the three-electrode tube. This is not all the story, for, when the tube is made in large sizes, it can be used for producing alternating current of high frequency and of considerable power, and then it can be employed for transmitting electric waves. Moreover, by giving another aspect to its functions, the triode can be used for modulating the alternating current just spoken of, and so for impressing upon the waves the human voice. In this way speech has been transmitted freely across the Atlantic, being received, it need hardly be said, at the distant end by the aid of other of the protean properties of the ubiquitous three-electrode tube.

In passing, it is worth remarking that the process of thermionic evaporation is really a method of obtaining electricity from matter without the use of moving parts—that is, without machinery. Possibly it may lead to the long-sought-for method of obtaining electricity and power direct from fuel without steam boilers or engines or dynamos. In other words, the electric engines of the future may be based upon thermionic processes deriving their energy direct from coal. Before that time comes, substances may have been discovered from which the emission of electricity takes place more easily than it does from the refractory metals we most frequently employ in the filaments of three-electrode tubes. It is known already, for instance, that some of the earthy oxides are greatly superior to platinum or tungsten in this property of emission of electricity. A new condition of matter, or a new substance, may be involved here and awaiting investigation.

The development of the three-electrode tube from fundamental ideas can be traced a long way back. The use of auxiliary electrodes in order to influence the current passing between two main electrodes in a vacuum tube has often been proposed, and had to some extent been applied before the method of obtaining the electrons from a hot filament was introduced into wireless telegraphy. Even after the use of the third electrode had been combined with the use of a thermal source of electrons many minds and hands were needed, and many years elapsed before the researchers themselves realized how useful the contrivance was destined to become.

As has already been hinted, the three-electrode tube (which will in future be called briefly a "triode") has found applications in every branch of wireless telegraphy and telephony, as will be shown shortly. There is no doubt it will prove equally useful in other branches of applied electricity and also as a tool in the hands of the experimental physicist. For instance, one fundamental property of the triode is that an electrical influence in one circuit may, by acting upon the control electrode, be made to exert effects in another circuit without suffering appreciable reaction; which implies that practically no energy is absorbed by the control electrode, not even so much as would be used up in setting a galvanometer needle into motion. This property alone should make the instrument welcome as a tool in the physical laboratory.

Then, again, the combination of triodes in cascade so as to obtain very large magnification opens up new regions of research by aid of the ear, and sanguine persons even anticipate that we shall some day hear the clatter of the collision of individual atoms with one another. Besides this, there is the fact that the triode provides a very convenient means of generating oscillations of exceedingly high frequency, which opens illimitable fields of measurement upon the properties of matter and of electric waves.

Amplifiers using several triodes have been made in thousands during the war for use in earth telegraphy, in submarine listening, in telegraphy by certain invisible rays or by electromagnetic induction, as well as for use in wireless telegraph stations. Besides this, it is possible to build amplifiers for work at ten or twenty vibrations per second, using a vibration galvanometer as the indicating instrument. *The sensitiveness of some apparatus developed in my laboratory during the war is such that it is possible to detect with certainty alternating current corresponding to one ten-thousand-millionth part of a volt at the input side. Magnifications of the order twenty thousand times are here involved.* This tempts one to revive old dreams of trans-oceanic telegraph by means of alternating currents delivered into the sea at the ends of long cables. *Calculation shows that by aid of a cable fifty miles long on each side of the Atlantic Ocean, capable of delivering about forty amperes alternating current of frequency 20 cycles, telegraphic communication ought to be possible by aid of the three-electrode tube.*

Perhaps the uniform generation of electrical oscillations in a circuit by aid of a triode is one of the most striking and fascinating of its applications. Not that there is anything visible, for, in fact, rather special apparatus is required to tell that oscillation is taking place, and the interest excited is, therefore, scientific.

It is usually found on analyzing an oscillator that the maintenance of the oscillations largely depends upon the interaction of two portions of the circuit on each other. If it be arranged that these two parts can be separated so as to interact less strongly the oscillation becomes weaker. There is a critical setting where oscillations are just not maintained, and the system is poised in suspense, so to speak. When it is in this condition, a very feeble stimulus, if properly timed, can provoke the system into vibration; the resulting display is energetic to an extent out of all proportion to the initial stimulus. Evidently enormous magnification is possible in this manner with a single triode. Its most important application is in wireless telegraphy, and many ships are equipped with this type of receiver. By its aid spark signals can be read at distances that are amazing compared with the old records.

(*Continued on page* 245.)

"Why I Am Opposed to Radio Government Control"

By DR. LEE de FOREST, Ph.D.

The Secretary of the Navy has recently undertaken steps to inaugurate new legislation for direction and limitation of radio communication in the United States. It appears to be a renewed effort to intentionally hamper the development of this art along the lines which Congress refused to sanction during its last session.

There has been during the past a large amount of unnecessary interference on the part of commercial and amateur stations, with the Navy stations, and also a very large amount of unnecessary interference on the part of Naval stations with commercial stations, and with each other.

For years it has been perfectly obvious to all radio men familiar with the problems of interference that undamped wave transmitters would enormously decrease the interference nuisance and permit a relatively large number of simultaneous communications in the same region without interference.

Intelligent effort on the part of the Navy to reduce this interference without at the same time strangling all independent radio development, and destroying any extremely important and rapidly growing interest on the part of thousands of wide awake American youths should be directed to scientific methods of reducing wireless interference. Had he taken this course the secretary would find little, if any, opposition on the part of radio amateurs or manufacturers. Instead of this, however, the administration advocates recourse to Government ukase, legislative straightjacket, and the etheric curfew for radio babes.

Yet after three years of unrestricted authority, it is not surprising that as the time draws near for the emancipation of radio from the Navy's era of "Thou Shalt Not," an effort should be made to continue its unreasoning and unscientific methods of solving an unnecessary problem in the wrong way. The average radio amateur knows enough of the principles involved in radio communication, and of the extreme selectivity, which the pure undamped wave makes possible, to realize that the problems of interference would largely vanish with the spark gap. Let the amateur urge upon his Congressman or Senator that if the Government wishes to further legislate against radio interference, such legislation should be first, simply to legislate out of business the damped wave transmitter; second, to assign to the amateur a zone of wave lengths from 50 to 400 meters. The International Regulation calling for a 300-meter emergency wave length for ship use is indisputably an unnecessary restriction on amateur activities, and is infallibly used as an argument as to why he should not be permitted to use above 200 meters. The 300-meter wave is never used except to salve the Radio Inspector's conscience on inspection days. They frankly admit that the 300-meter wave is a joke. And thirdly, to restrict his power transmitter to half K. W. or less if within a distance of 15 miles of a Navy station, and to one K. W. within a distance of 50 miles of a Government station.

Then it would be found that the amateur and not the Navy would be the one who would suffer from interference, a condition which would exist until the Navy becomes as up-to-date as the new amateur, and junks every one of its spark transmitters.

By GREENLEAF W. PICKARD

I am opposed to Government monopoly of radio communication. As a citizen of this Republic, and expressing what I believe to be the opinion of a majority of my fellow-citizens on the subject of Government monopoly of public utilities, I do not believe that such monopoly can place at the disposal of the general public the same facilities which would be and are being given by private enterprise. It is inevitable that politics rather than service becomes the controlling factor where and whenever a democratic government undertakes to operate a public utility. And where politics, or indeed any consideration other than service to the public enters, disintegration sets in because of lack of public support. Public opinion is today crystallizing against government ownership. Justice Charles Evans Hughes, speaking before the Institute of Arts and Sciences, recently characterized as "enemies of liberty"—

"All those whose interest lie simply in extending the activities of Government so as to embrace all industry. It cannot fail to be observed that even in connection with the war, despite the endeavor and patriotic impulse of countless workers, inefficiency in important fields of activity has been notorious. The notion that the conduct of business by Government tends to be efficient is a superstition cherished by those who either know nothing of Government or who know nothing of business. The instinct of the American people, I believe, can be trusted to thwart the insidious plans of those enemies of liberty who, if given their way, would not stop short of a tyranny which, whatever name it might bear, would leave little room for preference as compared with Prussianism.'

Speaking as one associated with radio communication since its very beginning in this country, and who wishes to see its future bear out its present promise of dominating the entire field of communication, I can frankly say that I see disaster ahead if Government monopoly of radio should come to pass. I am an inventor in this art, and I know that development is merely another name for invention. Whatever stifles invention stifles the art. America is first among the nations in her development of the useful arts, for she has provided the soil for invention—competition. Perhaps in the millenium we may say with Kipling—"And none shall work for money, and none shall work for fame"—but today the inventor's spur is the hope of reward and renown.

What hope of either reward or renown has the Government employee? Private enterprise richly rewards the successful inventor, and as a result we have our Morse, our Bell, our Edison and our Wrights.

Where is our Government inventors' Hall of Fame?

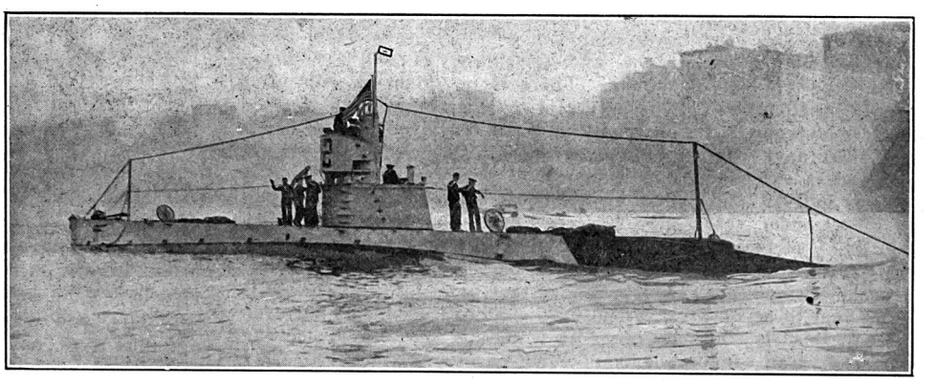
Under private enterprise, free of muzzling restrictions, men of vision in this art stand ready to draw aside the curtains of the future. If radio is to be a Government monopoly, its future will be but a petty development of its present; the larva will not cast its cocoon of red tape and acquire wings.

We stand today at the parting of the ways, and the issue before us is broader than radio. Shall we encourage invention by the reward private enterprise offers, or shall we kill the spirit of initiative by Government monopoly? The scripture saith, "Thou shalt not muzzle the ox that treadeth out the corn."

Underwater Submarine Telegraphy

A practical demonstration of what an American submarine can do in war in respect to maintaining communication when submerged was given in the Hudson River, New York, N. Y., off 96th Street.

Submerged at a depth of fourteen feet and making headway at five miles an hour the H-2 communicated flawlessly with the destroyer Blakely, thereby establishing a record as the first submerged craft to actually communicate.



The U. S. Submarine H-42, Which Established a Record in Under Water Communication. Note the insulated under-water aerial.

Transmission was possible up to 100 *miles;* however, reception may be effected from several thousand miles.

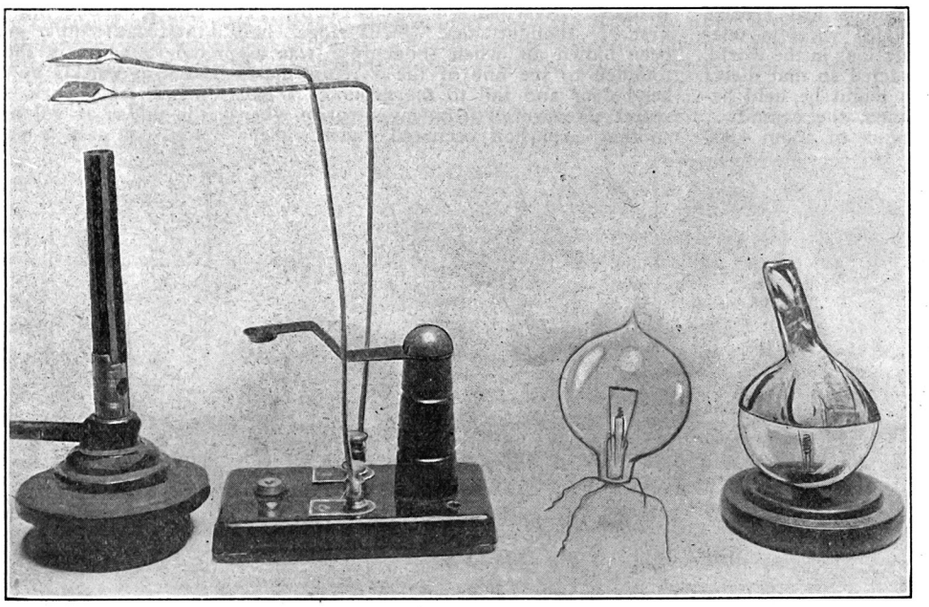
The H-2 while submerged, the periscope was in play from left to right

(*Con. on page* 261)

Developing an Audion for the Amateur

By E. T. JONES.

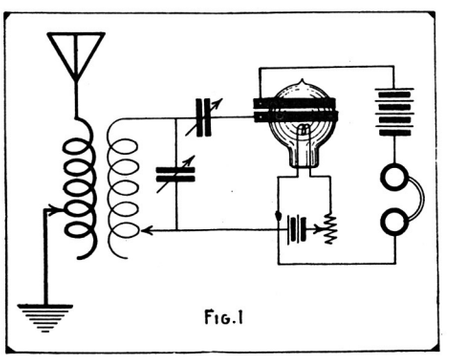
FATHER Gernsback, as usual, with the needs of the amateurs always uppermost in his mind, planted on my desk one afternoon some ordinary double filament 8-volt auto lamps and began seriously: "With your experience in connection with the handling of vacuum tubes and their associated circuits, why cannot you develop some method of utilizing these lamps as substitutes for the regular vacuum tubes?" We both considered and acknowledged the many disadvantages which such a crude lamp offered. However, I agreed that an investigation of the subject was worth the time and expense. With the hearty co-operation of **Mr. Kraus,** Field Editor, ELECTRICAL EXPERIMENTER, we immediately began experiments along this line in a quickly arranged "audion" laboratory.



Apparatus used in conduc ing the Audion experiments.

Anyone who understands the fundamental principle of operation of the vacuum tube will immediately condemn such an undertaking; however, it is only by bringing to the attention of our multitude of readers the prospects of such an accomplishment that further improvements will result, the total of which may furnish us the desired article.

First of all, let it be understood that at all times when working with vacuum tubes *—the grid must be placed between the filament and plate,* and absolutely no response will be had when employed otherwise. One of these schemes is shown in Figure 1, and has been claimed by several contributors to possess merits worth while. In order to prove their statements, tests were conducted and several standard vacuum tubes of modern design were used.



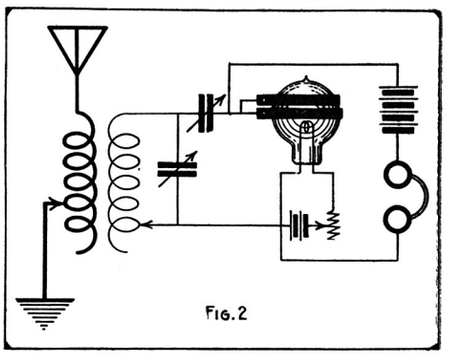
In this experiment the external grid and plate were connected in the circuit as in the standard Audion hookup.

It was found that with an *external* grid placed parallel, and in every possible angle to the plate and filament, *no response was had in the telephones.* If the connections are changed as shown in Figure 2, where the two plates are connected together and used as the plate of a Fleming Valve, signals from the local Naval Station (NAH) were recorded fairly well, and the valve actually functioned as a rectifier or detector. This circuit with 150 volts on the plate gave approximately 1/30th the response possible with an ordinary crystal detector. This then made it advisable to abandon further experiments with single filament lamps.

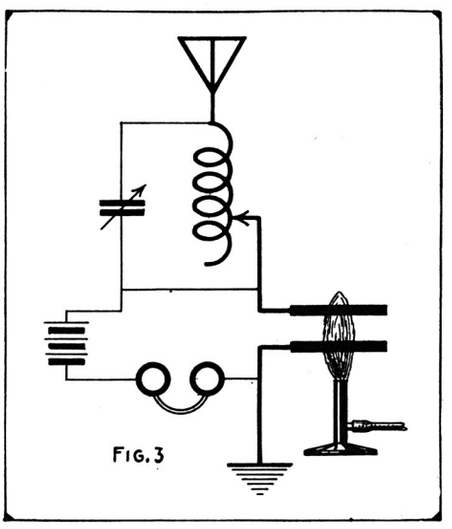
In order to carry out this work systematically we began our experiments, starting in where Dr. Lee DeForest, our esteemed contributor of the third and vital element of the present day vacuum tube, began.

We repeated the experiments of the eminent scientist and it was an exceptionally interesting procedure.

The first along this line was, naturally, that employing an ordinary bunsen burner and two electrodes in the outside envelope of the flame shown in the photograph; and the circuit used is given in Figure 3. The local Naval Station NAH was received faintly, but as was clearly evident, the adjustment of the plates in respect to their separation was necessary, and several times the signals were increased by the adjustment of the plates in the flame. Of course at its best this did not give much result



Here the two external elements are connected and used as a plate of a Fleming Valve.



Next Dr. Lee DeForest's stunt was tried out by inserting two plates in a Bunsen flame.

but served as a purpose to demonstrate the requisites of the present-day vacuum tube. It will repay many an experimenter to conduct just such tests, as it is from "seeing" that one gets into the habit of "believing," and there are many points in connection with vacuum tubes to see and believe from this crude arrangement.

The circuit devised by Dr. DeForest to disprove the rectification theory was also tried. Having a two-filament lamp at our disposal the circuit shown in Figure 4 was tried, and it made absolutely no difference, as the Doctor pointed out previously, whether the plate was maintained cold or heated by an external battery supply. As shown at 4-a, the two filaments were heated and at 4-b but one was heated—the cold filament taking the place of an ordinary plate in the Fleming valve—this then, proved very convincingly that no "rectification" was taking place between the two heated sources; and since it mattered not whether the elements inside the bulb were

(*Continued on page* 252)

Destruction of the Brussels Radio Station in 1914 By An Eyewitness

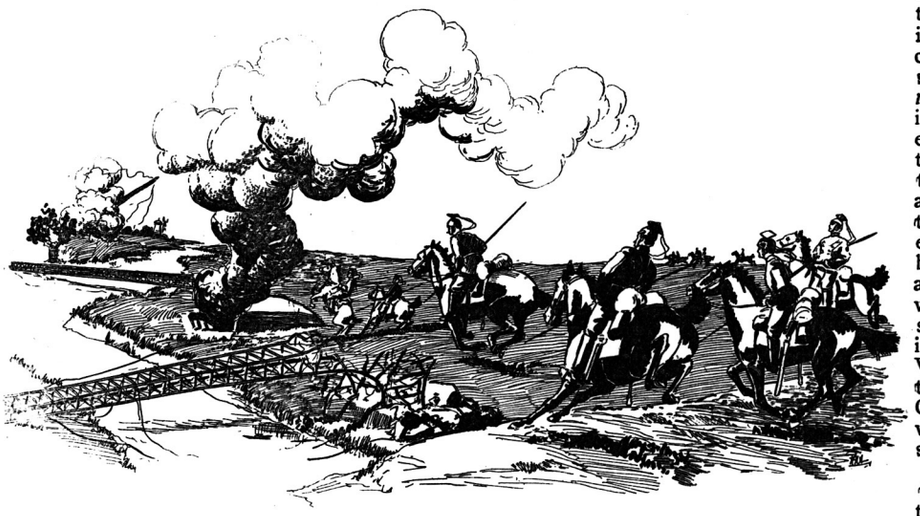
By HENRY M. de GALLAIX

IN the neighborhood of Brussels, upon a plot of ground given by King Albert, Mr. Robert Goldschmidt had erected one of the most powerful wireless telegraphic and telephonic stations in the world. This station was constructed so that direct wireless communication might be held between Brussels and Boma, the capital of the Congo State, a distance of about 4,000 miles. After trials extending over two years. Mr. Robert Goldschmidt succeeded in establishing communication with Boma three or four months before the declaration of war.

Current was supplied by a high-frequency alternator driven by a motor of 400 horse-power, the current for which was supplied by an adjoining local supply at 6,000 volts. The maximum wave length was about 10,000 meters. The antenna consisted of 77 wires supported by eight steel masts of 7 square meters in cross-section placed in two parallel rows. The height of the two masts nearest to the station was 630 feet and that of the remaining six was 300 feet. All the masts were stayed with numerous steel cables. In the month of August, 1914, the foundations of a ninth mast of the same type as the others was commenced. This mast would have been square in section, the sides being 18 feet long and 1,000 feet in height, and arrangements had been made for an electric lift to reach the top. It was to be placed between the other masts to raise the antenna, and thus increase the radius of action of the installation.

On Wednesday, August 19, of the year 1914, the most contradictory rumors reached Brussels. Some folks affirmed that the Germans were at Louvain and would not stay to enter the capital. Others said that the town was protected by a ring of troops. Nevertheless, the hurried departure of Queen Elisabeth appeared to support the views of the pessimists. Another event more unexpected and more convincing succeeded in persuading all that the enemy was at hand.

About one o'clock in the afternoon a violent explosion was heard in the direction of the wireless station at Laeken, near Brussels. By chance I was close by. At first I thought that the bridge had been blown up, when suddenly I was astounded to see one of the wireless masts bend over and fall to the ground. I had scarcely recovered from my surprise when another explosion occurred, more violent than the first, and a second mast fell. "They are blowing up the station; the Germans must be near," I said to myself. I tried to get nearer, but at 200 meters from the station I was stopt by a cordon of town guards. By making a detour I was able to skirt the station, and was then only separated from it by the canal of Willebroeck.



"I had scarcely recovered from my surprise when another explosion occurred, more violent than the first, and a second mast fell"

I waited for some moments, and then the characteristic throbbing of a Taube aeroplane made me lift my eyes. It came slowly toward me, gradually descending until I could quite clearly see the black cross painted on its wings. It flew over the station, encircling it twice, and was starting in the direction of Louvain when suddenly a shot was fired near me; others followed and continued unceasingly for some minutes. The Taube aeroplane, finding itself a target, turned slowly and disappeared. A group of Belgian military engineers ran to the other side of the canal and called out to me: "Look out! Run for your life!" Without knowing why, I ran back some yards. A third explosion occurred, and a third mast fell to the ground. The soldiers returned, and one after the other the masts fell. The soldiers had cut the cables on one side so that the masts bent toward the other side; then, having mined the foundations, they fired the fuse and ran back as quickly as possible, while the light metal framework slowly crumpled up in the midst of volumes of thick, black smoke.

In one case a mast was prevented from falling by the antenna of a neighboring mast. In another case the first explosion only shook the mast, and the blasting had to be repeated once or twice until the mast was utterly destroyed. At about half-past three the antennae were entirely destroyed, but the transmitting and receiving station was still intact. This station was situated in a tunnel under the Vilvorde Road, between the Willebroeck Canal and the ground where the masts had stood.

It was only possible to carry away some of the light instruments; the remainder had to be destroyed. The most delicate parts were broken up with hammers, and to complete the destruction the station was blown up with dynamite. The explosion was so violent that part of the granite parapet was broken and a large crack opened in the roof of the tunnel. Finally, so that even the ruins could not be put to any possible use, the station was filled with straw and hay and set on fire. A dense smoke rose from the tunnel. It was seen rising over the canal until the evening, and the last bursts of flame were not extinguished when a detachment of the enemy's cavalry appeared on the scene.

We heard afterwards that the Germans had hoped to seize the wireless station, which would have put them into communication with the most distant points of the theater of war. Orders had been given to a troop of cavalry to advance by forced marches to prevent its destruction, but the Belgian authorities, warned of this move, were able to forestall them. The German plans were frustrated, but the defeat cost Mr. Robert Goldschmidt not only an enormous sum of money, but also the patient research and labor of three years.

AMATEUR LICENSES

DEPARTMENT OF COMMERCE
Navigation Service
Office of Radio Inspector
Customhouse
New York, N. Y.
September 30, 1919.

Editor RADIO AMATEUR NEWS.

Sir: The Navy Department's restrictions on the operation of amateur stations and technical and training school and experimental radio stations will be removed October 1. Please bring to the attention of the amateur fraternity that it will be necessary for amateur operators to obtain authority from the Radio Service, Bureau of Navigation, Department of Commerce, before their stations can be re-opened.

Amateurs of the 2nd District should communicate with this office *by mail,* requesting application forms for station and operator's licenses, and these will be issued as promptly as possible. Letters should be addressed to Chief Radio Inspector, Room 603, Custom House, New York.

Because of the great number of applications which we expect, it will be impossible to issue station and operator's licenses immediately, but temporary permits will be issued based on these applications if the information thereon indicates that the radio equipment and the operator comply with the requirements of the law as to amateur stations and operators.

Respectfully,

L. R. KRUMM,
Chief Radio Inspector.

170-25000 Meter Receptor for all Types of Radio Communication

By FRANCIS R. PRAY

IT seems to be the trend among present-day amateurs to do away with the large and imposing panel receptors used in pre-war times. The real wireless bug is forever experimenting; trying out new circuits and apparatus. To do this, he must have a very versatile outfit but unfortunately, many accomplish this end by spreading the odd parts of the outfit over the table. We all know that this is poor practice; the long leads and false capacities presented being exceedingly out of place in the modern delicately balanced circuits.

Accordingly, I have designed a set for the amateur which will accomplish three primary objects, namely:

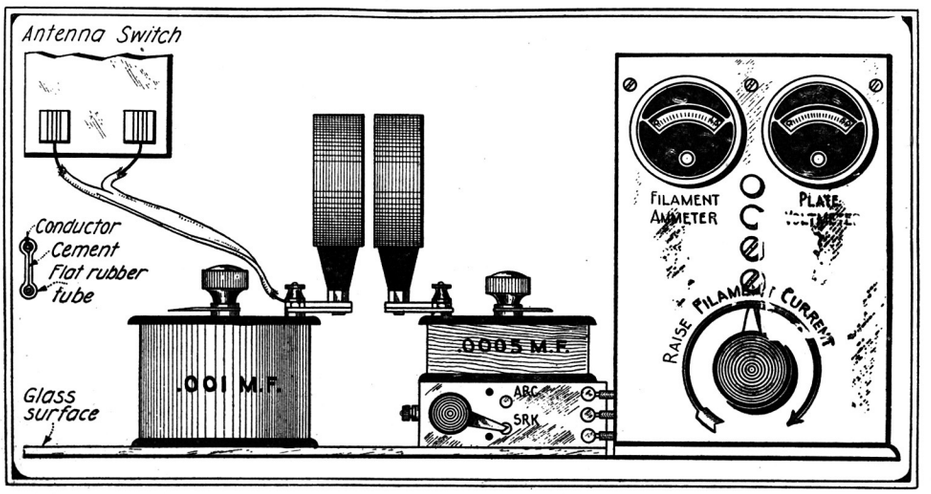
(1) A simple, efficient circuit for any type of reception.

(2) A careful selection of stock apparatus, wherever possible, from the best radio companies catering to amateurs.

(3) Extreme versatility; enabling the amateur to compare other circuits with his own standard, without dissembling his set.

The many advantages of such a set will at once become obvious; the most important is that all parts with the exception of the split condenser box can be used in any circuit and will never be entirely obsolete. In fact, the primary tuning element makes an excellent wavemeter and with the secondary tuning unit, accurate calibrations of radio inductances, capacities, wave lengths, *et cetera,* can be made by the three way method as explained in the text-books.

Previously, it has been the policy of magazine writers to exclude the names of manufacturers from their articles as much as possible. However, the success of our magazine depends on the support of the advertisers, so if they have something of merit, we might as well admit it. It will be "casting bread on the waters." Therefore, do not be surprised to see names of radio companies in the following text.



This shows the general design of the complete receiver. The coupling is obtained by adjusting the two coils shown in the center.

The hookup is the famous Eaton Circuit and is used by the U. S. Navy. What more can be said in recommendation? Any time you read of a new receiving record, rest assured that you can duplicate it by using this circuit, providing your antenna system is O. K. It is also possible to receive on a loop with this circuit and a modern two-step amplifier when after long wave C. W. stations.

If the prospective user of this circuit is not in a position to make the split condenser, he can buy this, together with the grid condenser and leak; adjusted to exact electrical dimensions to eliminate the plate circuit variable condenser; from the Wireless Specialty Apparatus Co., who supply these assembled in a cabinet. If the "standardized" grid condensers and leaks are used, it will be necessary to shunt the phones, or both phones and "B" battery, with a 43 plate Murdock Variable Condenser. However, if the grid condenser and leak are carefully built up until the correct size is reached, the use of the plate circuit variable may be obviated. To quickly bring the VT to the proper operating condition, the meters shown on the VT control panel are necessary, but if expense is an important consideration, these can be omitted. The plate voltmeter should be shunted across the "B" battery and the filament ammeter placed in series, in the "A" circuit, as shown in Mr. Brown's article in the September RADIO AMATEUR NEWS.

The VT control panel was designed to accommodate Weston Model 301 Meters (front mounting), as these are the best jewelled meters on the market at a reasonable price, and are also compact, being only 2¾ in. diameter and 1¼ in. deep.

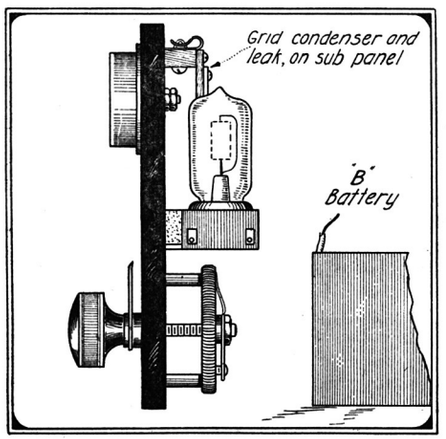
If the vacuum tube is mounted on the front of panel, there is great danger of some flying missile generally present in amateur stations, breaking the VT. Furthermore, the bulb, when placed in a horizontal position will slowly change its internal characteristics, due to sagging of the filament. Therefore, rear of board mounting seems to be the best. Sockets designed for this method of mounting, as shown in the drawing, are sold by the Somerville Radio Laboratory, 102 Heath Street, Somerville, Mass., at a reasonable price. It is to be noted that a small piece of soft rubber is supplied with the socket, to be placed between same and panel to take up vibration.

The best value for the money seems to be the Remler rheostat, which is seen below. Before drilling the shaft hole, a deep arc must be scratched out with a heavy pair of dividers and the arrow-head and tail cut into the Bakelite panel with a pen-knife. The recesses thus formed are filled with white lead. This makes a very neat indicating dial. The words—*Raise Voltage*—may be printed with white drawing ink. Other lettering such as *Arc* and *Spk.* may be done the same way.

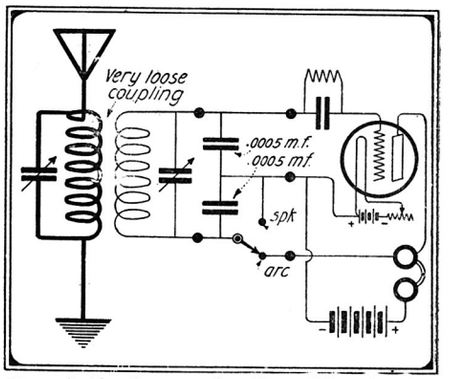
Using the parts prescribed, a panel size of six by nine by one quarter inches is correct. This may be supported by wooden or strap metal angles, screwed to panel and base.

Instead of placing binding posts on front of panel, Fahnstock spring binding posts (which are cheaper) are arranged on small subpanels of bakelite at the principal vantage points.

(*Continued on page* 245.)



Showing the arrangement of the Audion panel.



Here is the famous circuit used by the U. S. navy.

Awards of $100 Radio Prize Contest

2nd Prize Winner $25.00 in Gold

This Set Won the Second Prize and We Can Readily See Why. It Is Apparent That Highly Selective Tuning May Be Accomplished With This Set. The Idea of Using a Switchboard Plug Arrangement Is Certainly New and Novel.

AN IDEAL RECEIVING SET

By A. C. Burroway

AN ideal receiving set is a pretty large order, for the reason that the ideal receiving set depends for its operation on the vacuum valve. As every one knows, vacuum valve circuits are being constantly changed and new hook-ups are being evolved, so that the amateur who wishes to keep pace with the progress of the art must be constantly changing his circuits and adding to or subtracting from his apparatus in order to determine which is the most efficient for his particular case. Let us suppose for example that 9FX of Blanc—Wisconsin is getting excellent results on a certain circuit. He publishes this circuit in RADIO AMATEUR NEWS and Mr. A reads about it and wishes to try it out. But he finds that it will necessitate a considerable amount of work. The fronts of several small cabinets will have to be removed and connections be changed. New lengths of wire must be prepared and the soldering iron brought out, and when after much labor and difficulty the connections are finally complete they look like a briar patch, with ten chances to one that operation will not be at highest efficiency. Obviously then, the great need in the up-to-date receiving station is a means whereby any possible connection may be easily, quickly and efficiently executed. It is the purpose of this article to describe the apparatus necessary for such a system.

General Description.

GENERAL DESCRIPTION

With the exception of the receiving transformers, the apparatus is of the cabinet type, this style having met with increasing favor among the amateurs during the past few years. The new feature of the outfit consists of a "plug in switchboard" containing engraved in white on a black background of hard rubber or bakelite the circuits of the system. The board is fitted with plug holes and the operator is provided with a number of cords with plugs attached by means of which he may, in a few seconds' time, plug any of the well known valve circuits and when he is finished have a diagram of its connections before his eyes. The switchboard also provides a convenient means of experimenting on new circuits which will from time to time suggest themselves to the mind of the serious amateur. Such an outfit is the latest word in business-like, efficient, easy-to-operate apparatus.

Mr. Burroway, the Proud Owner of the Prize Receiving Set.

A general outline of the appearance of the completed station appears in Fig. 1. To the left is the long wave coupler mounted in an upright position to economize space. The middle cabinet contains the rest of the tuning apparatus, namely, four variometers and four variable condensers. On top of this cabinet is mounted the short wave coupler. It has two secondaries and is so arranged that different primary connections will make it available for waves up to 300 meters with the small secondary and up to 3,500 meters with the large secondary. The small secondary is arranged to be used as a tickler coil when not otherwise employed. It may be well to state here that two aerials are used, a small four wire for amateur waves and a very long single wire for the long, undampt waves. If it is convenient—the builder may employ an intermediate aerial corresponding to the intermediate division of the transformers, or he may employ any form of the underground aerial in addition to, or in place of any of the above, as this will afford opportunity to determine which gives the best results with the hook-up used. The cabinet to the right contains the vacuum tubes with necessary controls. Also a long-wave loading inductance which is varied by means of the five-point switch in the center. The first bulb is employed as a detector and the other three are used to amplify its signals. No connections between instruments

are made inside the cabinets, but the terminals of each are brought out to binding posts mounted along the bottom of each cabinet and from there connected directly to the switchboard. Apparatus such as the crystal detector, amplifying transformers, high voltage and filament batteries, etc., are connected at once to the switchboard from a shelf or some other convenient place under the table. The switchboard itself, which appears in Fig. 2, is set flush in the table top, and the wires from the instruments are run thru the table top and connected to the correct plugs as designated by the symbols on the board. The plugs and fittings are of the regulation telephone type. The switch at the left of the board is used to change from the large to the small coupler, and is so arranged that in the top position the large coupler is in circuit, in center position the 3,500 meter division of the small coupler, and in bottom position the 300 meter division. A standard telephone switch will do very well here if changed slightly to suit the purpose. To avoid confusion the circuits of but one coupler are shown on the switchboard, but as will be seen it represents any one according to the position of the switch. One variometer and one variable condenser are connected so as to be available in the primary circuit. The vacuum valves are of the V T type now on sale for amateur use by the Marconi Co. They are of constant voltage, thus eliminating potentiometers, and are much better oscilators than the old style bulb. They are mounted in a horizontal position, as indicated by the drawing, and can be inserted from the front. The filament currents are turned on by means of telephone switches and the brilliancy is regulated by the usual porcelain base rheostat mounted inside the cabinet and arranged to be operated from the front. They appear in the upper corners of the valve cabinet. An ammeter is connected in the circuits of the first valve, but is arranged so that any set of batteries may be tested by means of the cords. A voltmeter similarly arranged is also included. Blitzen amplifying transformers are used to transfer the energy. It will be noted that two plug holes often appear together. This is because it is often necessary to make more than one connection at the same point. Otherwise the switchboard is self-explanatory and needs no further comment.

CONSTRUCTIONAL DETAILS. DIMENSIONS

The cabinets are made of either walnut or mahogany with front panels of hard rubber or bakelite, and are identical in construction. They are 8 in. wide x 10 in. high x 25 in. long and are made of ¾ in. stock except the bases, which are ⅞ in. It is suggested that unless the builder is a good wood worker, the cabinets be made and finished at a reliable cabinet shop, as much of the appearance of the set depends on a good job here. The switchboard is ¼ in. x 10 in. x 78 in.

The following is a table of the capacities and inductances of the various units:

Condenser	Capacity in M.F.	Manufacturer
C-1	.001	Murdock
C-2	.0005	"
C-3	.0001	"
C-4	.005	"

Altho Murdock condensers are used by the writer, there is no reason why any other good condenser may not be substituted. The tubes for the long-wave coupler were purchased from the Clapp-Eastham Co., and are the same that are used on their "Cambridge Tuner." It might be a good idea to substitute the new De Forest honeycomb coils for this tuner, as they will take up much less room and present a neater appearance. The following are the dimensions for the Clapp-Eastham coils:

Coil	Size of Tube	Size of Wire	No. of Taps
Primary	7⅞ in. x 13½ in.	No. 26	34
Secondary	6⅞ in. x 13 in.	No. 30	18

The secondary loading inductance is wound with No. 28 wire on a tube 4 in. in dia. x 18 in. long, and is tapped at five places. The writer would advise the builder to make the variometers, as they require little work and will save considerable expense. They are identical in construction with the outer tubes, being 6 in. in dia., and the inner tubes 5 in. in dia. Both are 2 in. wide and are wound with No. 28 wire, leaving a space of ¼ in. in the center to accommodate a rod. Care should be taken to get the same amount of wire on each tube and to wind them in opposite directions. Green silk wire is used thruout.

SUGGESTIONS FOR CONSTRUCTION AND OPERATION

Four vacuum tubes may look pretty big to the amateur of limited means, but if he cannot afford all four he should at least build the cabinets to accommodate four, and add the others when he is able. This can be done at very little extra expense. It is a good idea to number the plug holes on the switchboard, two plugs at the same point, of course, receiving but one number. It then becomes a simple matter to make charts for different hook-ups by jotting down the connections. These charts should be kept in a file and will be found very convenient. Switches, taps, knobs, dials, etc., can be purchased from any supply house. In assembling the set be sure that every connection is soldered and that a good ground connection is provided. The completed outfit is a set any amateur can be proud of. It costs but little more than a similar outfit which is limited to but one circuit, and its wonderful flexibility and convenience will soon repay for any extra effort or cash that may be expended.

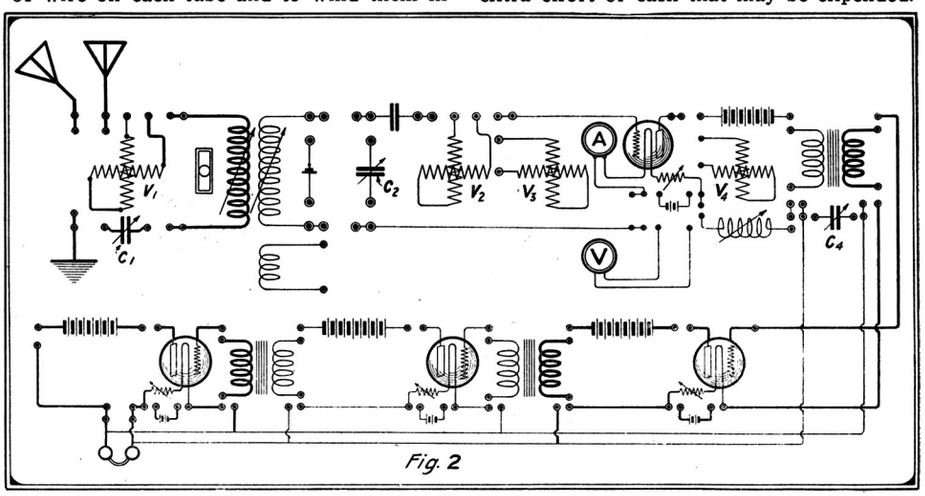


Fig. 2

The Arrangement of the Circuits May Be Clearly Understood From This Diagram. The Tiny Circles Denote the Plug Holes for Connecting the Various Instruments.

Amateur Radio Broadcast

Effective October 5th. A daily radio amateur broadcast schedule will be transmitted by Navy Radio New York (NAH), immediately following the Press schedule, which starts at 9.00 P. M. (Amateur broadcast will start about 9.40 P. M.). Transmission to be on 1500 meters.

The broadcast will commence with the words—Amateur Broadcast de NAH Break Code (Number of code will be inserted here) Break, and then the broadcast will be transmitted. Codes given below will be used.

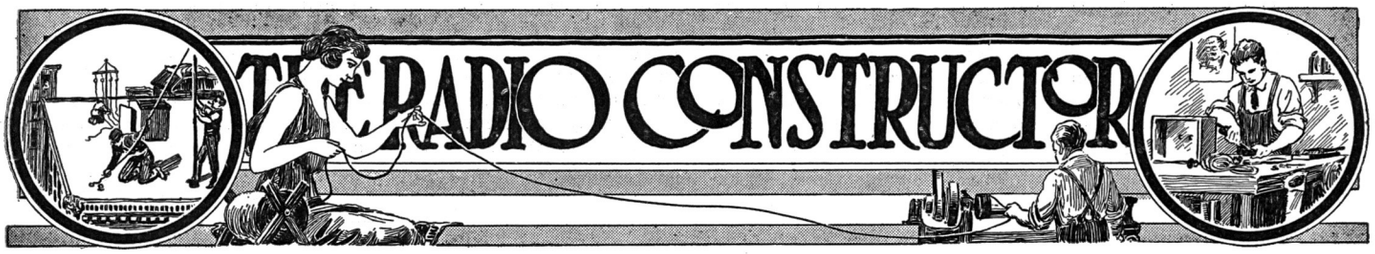
To decode, find letter transmitted opposite code number and then look at top of column for the correct letter.

Example: Use Code Number 10, NAVY would be "WJEH". RADIO would be "AJMRX".

R. B. COFFMAN,
Lieutenant Commander U. S. A.

U. S. Navy Dept.,
44 Whitehall St.,
New York City.

Code No. 2—	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
Code No. 4—	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
Code No. 6—	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
Code No. 8—	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
Code No. 10—	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I



A Damped and Undamped Receptor

By R. M. HENDRICKS

HOW would you like to have a receiving set that would enable you to listen to Arlington or Key West, and then by a twist of a knob would permit you to hear a fellow amateur's sending? Would not such a receiving tuner be just the type you have been looking for?

In presenting the design embodied in this article, I do not wish to pose as an originator of a new type of apparatus, neither do I wish to give the impression that the instruments here described are superior to anything on the market. I have, however, tried to eliminate the defects, principally mechanical, that seem present in most amateur apparatus. Therefore, I have attempted to produce a design pleasing to the eye, smooth in operation, simple in construction and of correct proportions and specifications from a radio standpoint.

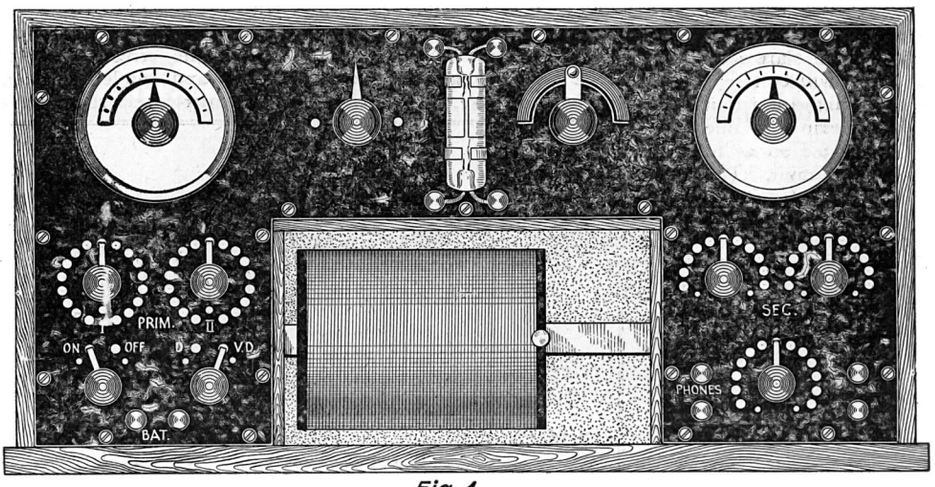


Fig. 1

Arrangement of controls on the panel. Note the opening in the center through which the coupling is regulated.

With this set as many as 50 different radio stations of from 200 to 3,000 meter wave-length can be received with but one adjustment of the primary circuit, while the rest of the tuning is in the immediate audion circuit.

The set is mounted of ¼-inch Bakelite-dilecto, which is set in a mahogany cabinet of suitable dimensions, having at least six inches clearance in back of the panel. The exact layout and dimensions of the panel can easily be calculated, as the illustrations are drawn to scale.

The loading inductance presents no startling improvements in design or construction, and the receiving transformer is just a good substantial piece of apparatus that any advanced amateur need not hesitate to construct or operate. The loading coil consists of a cardboard tube, 11 inches long and 4½ inches in diameter, wound in a single layer with No. 24 D.C.C. copper wire, with taps taken off at every 35th turn, thus giving a total of eleven taps. The most efficient way of taking off taps is by scraping the wire to be used for about an inch and then solder a piece of wire to it. It is good practice to shellac all windings when completed.

The receiving transformer. The reader will take notice that no metal (supporting rod) is used inside the primary or secondary windings. This transformer responds to wave-lengths as high as 2,500 meters, without the use of a loading inductance, and when used in connection with the average amateur antenna. The author used seven-eighths inch white wood for the ends of the transformer. We are now ready for the winding. The primary is wound on a cardboard cylinder seven and one-half inches long and five and one-half inches in outside diameter. The winding is of No. 24 D.C.C. or enameled wire; leads are taken off every twelfth turn and fastened in the same manner as described in the construction of the loading coil. In connecting these leads to the switch contacts the start of the winding is secured to the first switch point of P1, Fig. 1. The first lead to the contact one of P2, the second lead to contact two of P1, and so on until the entire 32 leads are distributed along the two switches.

The secondary winding consists of a single layer of No. 28 S.S.C. copper wire wound on a cardboard tube 5 inches in diameter and 7 inches long. It is tapt off at every thirty-fifth turn and the leads are brought in thru the inside of the cylinder. It may be found good practice to leave a space of about 1/16 of an inch between each thirty-fifth and sixth turn, so as to enable proper connections. The 13 leads are brought out thru the end of the secondary support and twisted tightly together, taking care to keep them well insulated from each other. They are then connected to their respective contacts on switch at the right in Fig. 1. The construction for the slider upon which the secondary moves shown at Fig. 3, and is made of half-inch wood.

There are two, standard make, variable condensers used with this set, one having a capacity of .001 mfd. consisting of 43 plates and a smaller one of 17 plates, about .0003 mfd. These are mounted as shown in Fig. 2.

The loading inductance used in the audion circuit consists of a layer of No. 30 D. C. C. copper wire wound on a tube 4½ inches in diameter and 2½ inches long. Twelve taps are taken off at regular intervals, and the leads are brought to the contacts of switch L2 at Fig. 1.

The rheostat for the low voltage battery, 6 volts, is of the standard porcelain, back mounting type which can be purchased from any reliable dealer. It is fastened to the back by means of machine screws.

In the illustration and also in the original set, the regulation of the high voltage battery was provided by means of a graphite potentiometer. This has many advantages over the switch point type of regulation, one advantage being that it assures finer regulation. Fourteen 3-volt flashlight cells constitute the high potential battery.

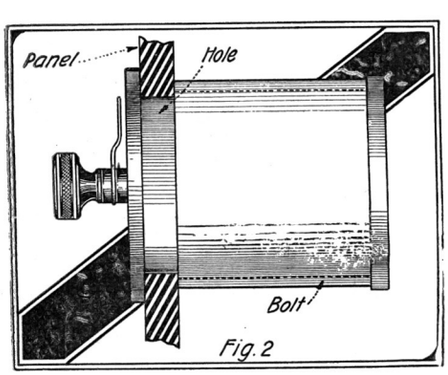


Fig. 2

This shows the method of mounting the condensers.

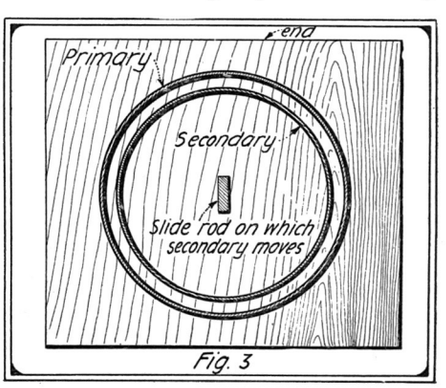
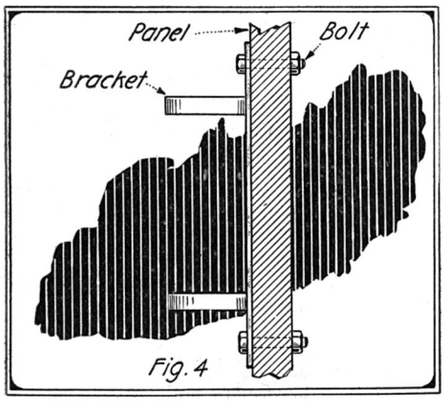


Fig. 3

End view of the coupler showing the method of mounting the secondary.



This shows the method of fastening the Adapter.

When purchasing the potentiometer be sure that the switch arm is provided with a graphite contact, as the rough surface of the graphite sector will spread fine particles of brass along its surface if a brass contact is used. This lowers the resistance qualities of the potentiometer.

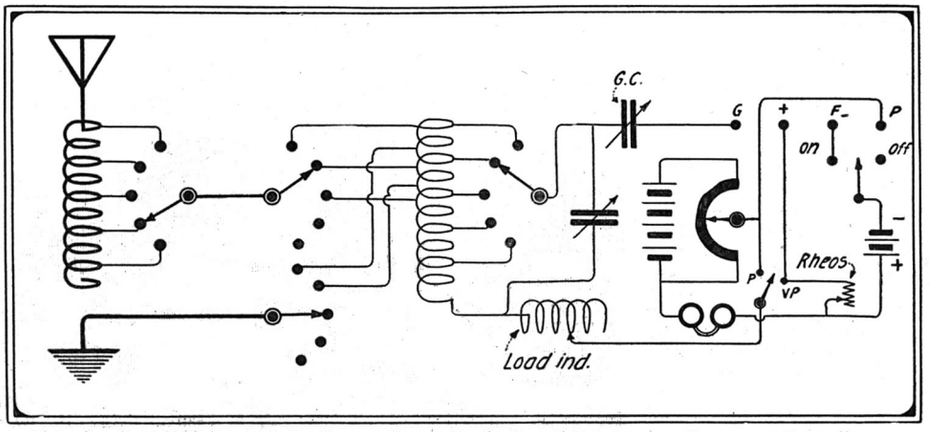
The audion bulb is supported by a tubular adapter which can be purchased with the bulb. The screw base is cut off and holes drilled for machine screws. It is then mounted as shown in Fig. 4.

There are two double point switches at the lower left of the panel Fig. 1; one is used to turn the filament on or off and the other is for changing from damped to undampted reception. The connections for these switches are shown in the wiring diagram.

The knobs and binding posts are made of hard rubber, the knobs being about one inch in diameter and the binding posts about ½ inch. These, however, can be substituted to the reader's own desire.

After the panel has been laid out, the rheostat, switches, contacts and binding posts are mounted. Then the variable condensers should be attached to the panel and the leads from the transformer and loading inductances should be soldered to their respective contacts. The panel is next set in the cabinet and the two held together by means of ¾-inch nickel-plated wood screws.

Phones of two or three thousand ohms may be used in connection with this set. During operation the filament and primary circuits are adjusted first and last, but not least; the immediate audion circuit is adjusted.



The circuit which is used in the receiver. Note the switch connections for the primary and secondary.

Amateur Radio Operators!

Before operating transmitting stations it is necessary to take an examination and secure an operator's license and have on file with the district radio inspector a formal application for station license. If there will be delay in issuing your station license, the radio inspector can assign radio call letters when the application is received.

All amateurs should be familiar with the Radio Laws and Regulations. This publication can be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 15 cents.

All transmitting sets should be inductively coupled. Stations having what is known as plain aerial, or the spark gap directly in the antenna circuit, will not be licensed where they do not comply with regulations 3 and 4 of the act of August 13, 1912.

The List of Radio Stations of the United States, edition of June 15, 1919, does not contain amateur stations. This publication can be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 10 cents.

A list of amateur stations may be published about the 1st of January, 1920.

Any additional information required by amateurs may be obtained from the radio inspectors of their districts. Their addresses follow:

Radio Inspector, Customhouse, Boston, Mass.

Radio Inspector, Customhouse, New York, N. Y.

Radio Inspector, Customhouse, Baltimore, Md.

Radio Inspector, Customhouse, New Orleans, La.

Radio Inspector, Customhouse, San Francisco, Calif.

Radio Inspector, Federal Building, Detroit, Mich.

Radio Inspector, Federal Building, Chicago, Ill.

Radio Inspector, 205 Citizens Bank Building, Norfolk, Va.

Radio Inspector, 2301 L. C. Smith Building, Seattle, Wash.

The territory covered by each district is shown on page 68 of the Radio Laws and Regulations. Amateurs in the fourth district (headquarters, Savannah, Ga.), should address their communications to the Radio Inspector, Customhouse, Baltimore, Md.

Notes on R-34 Return Trip

The following communication was received by us from R. F. Durrant, Lieutenant Royal Air Flying Corps:

121 Broadway,
Cricklewood,
London,
England.

Editor
"Radio Amateur News,"
New York, N. Y.

Here's a little dope on our homeward flight; it may interest your radio bugs. All radio men in British Air Service devoured the first number of your magazine and all vote it should be *"Radio News,"* short and to the point. I have just received your August issue; many thanks for the article on R34. We shall be pleased to correspond with any amateur or professional who likes to write to me and so strengthen the radio link between the old and new worlds.

R. F. DURRANT,
Lieut. R. A. F.

P. S.: "Radio Amateur News" was the first radio paper to cross the Atlantic by air.

FROM NEW YORK TO BRITAIN BY AIR

Notes on R34's Return Trip.
By R. F. Durrant, Lieut. R. A. F.

I HAD to drop one radio man before starting on the return flight as we were taking an extra engineer.

With a forty-knot breeze in our favor we were soon doing 80 knots and NAH kept us busy copying weather reports from the U. S. Weather Bureau, which were extremely valuable.

The radio sets were working O. K., vibration loosened a filament connection on our transmitting tube which caused Otter Cliff to say "your bulb is not very good," but this was soon rectified. I spoke Canso on my radiophone and he reported speech clear and on his spark said "that's the stuff to give 'em."

The day is dawning when aircraft will forsake telegraphy for telephony.

We worked NAH, NBD, the Dominion, Megantic, etc.

Dominion said shall I fire a gun if I see you. I Morsed back "Don't bother 'em." Clifden was stronger on return, which shows our aerial is slightly directive.

Thirty thousand words were sent and received during homeward flight.

St. Johns, N. F., was in touch up to 1,800 miles; this breaks all radio records in aviation.

My sole operator was so fagged when we landed that he fell asleep directly he touched terra firma. I felt the strain myself for several days, as we had to keep all dynamos and lights going, as well as the radio. Walking thru the London streets *I could hear strong sigs in my ears!* . . . . the result of our long vigil.

The Construction of a Receiving Cabinet of Latest Design

By PALMER H. CRAIG

IN view of the fact that the design and construction of radio apparatus has undergone a radical change during the period of the war, and realizing that the progressive amateur wishes to "keep up to the times" and improve his apparatus, the writer has outlined in the following article a receiving outfit which is the "last word" in radio design and efficiency.

The set herein described will respond to wave lengths considerably in excess of 15,000 meters, and is entirely self-contained and employs no external loading coils or couplers, the tuning being done by means of compact "pancake" inductances contained within the cabinet. It will be noticed that a "balanced" hook-up is used which is extremely selective and which reduces static to a minimum. Using this outfit with a good amateur aerial no difficulty should be encountered in picking up practically all of the foreign stations.

Figure 2 gives the dimensions and coupling arrangement of the three pancake inductances I_1, I_2, and I_3. These three coils are of the same size, being made by winding turned wooden spools with No. 28 SCC wire. It will be noted in the hook-up shown in figure 1 that two primary coils are employed with one secondary. When the long wave transatlantic signals are to be received each coil should be wound with 1,416 feet of wire, six taps being taken off at regular intervals. This will make the coils the correct size to respond to wave lengths of 15,000 meters, which is large enough to pick up practically all of the long wave signals. The writer strongly advises the amateur to wind these coils with exactly this much wire, as no more is necessary and any less will make it impossible to tune to the longer wave lengths. However, should the amateur desire to receive only stations operating on a short wave the coils can be wound with less wire. The exact amount of wire necessary can be ascertained by formula as follows:

By exhaustive experiment it has been found that the natural wave lengths of each of the three coils employed in this circuit should be as follows in order to respond to the following wave lengths:

Max. W. L. to which circuit will respond	Natural W. L. of each coil	Class of signals which can be received
375 meters	43.10 meters	Amateur
730 "	83.95 "	Commercial
1,460 "	167.90 "	Commercial
2,200 "	253.00 "	Navy
2,850 "	327.75 "	Time—Weather report
15,000 "	1,725.00 "	Foreign

Knowing what the natural wave length of the coils should be, we have the following formula for the number of feet of wire on the coil:

$$F = \frac{W \times 39.4}{48}$$

Where F = number of feet of wire to be wound on coil,
and W = natural wave length of coil.

Hence the exact amount of wire necessary to make the circuit respond to any of the above wave lengths can easily be computed. It must be understood, however, that the above table is applicable only to the circuit which is herein described, and is only accurate when .001 mfd. condensers are shunted across the primary and secondary coils.

The method of varying the coupling of the coils is shown in Figure 2. It will be noted that the middle or secondary coil is stationary while the position of the other two is variable by means of a gear rack arrangement controlled by knobs on the front of the cabinet. The taps are brought out with flexible wire and switches for them are arranged as shown in Figure 3.

It is of the greatest importance to be sure that the primary coils are connected *with their fields opposing.* Note carefully the connections as shown in Figure 1. The gear rack arrangement is shown in Figure 2. With this method of varying the coupling of the coils, critical adjustment is possible and the circuit is made extremely selective. As shown in Figure 1 a vernier scale attached to the knob operating the gear rack makes a convenient method of noting the coupling of the coils in receiving a certain station. While not absolutely necessary, this scale is very convenient.

S_1 is a condenser switch for switching the primary condenser, V_1, either in series or shunt with the primary coils. When receiving short waves, throw the primary condenser in series, and when receiving long waves throw the condenser in shunt. The primary condenser V_1 should be of the rotary variable type with a capacity of .001 mfd. The secondary condenser V_2 is identical with V_1.

S is a double-pole, double-throw switch audion circuit should be used for the reception of continuous waves and the audion circuit for the reception of damped waves. The former hook-up is a regenerative one, and causes the audion bulb to oscillate easily. This switch furnishes a convenient and simple way of quickly changing from one circuit to the other.

S_3 is a double-pole, double-throw switch for changing from the crystal detector to the audion circuit. Throwing this switch makes the complete change to the crystal detector—no other change being necessary provided the switch S_2 is on the ULT. circuit and S_3 thrown to the right.

S_4 is the switch for varying the capacity of the grid condenser. It has been found that the capacity of the grid condenser should be variable, and yet each capacity may be fixt; hence this type of adjustable fixt condenser is especially efficient. The condenser is made by mounting twelve pieces of tinfoil 1 inch square between thirteen pieces of mica 1½ inches square, and moulding the entire unit in paraffin after leads have been brought out from each sheet of tinfoil. By means of the switch S_4 variable capacities may be used. The switch itself is made by mounting a metal sector on a rotary knob so that the metal fin will connect the switch points together as it revolves over them. This throws any number of the sections of the condenser in parallel, thus varying the capacity.

S_5 is a three-point switch controlling the

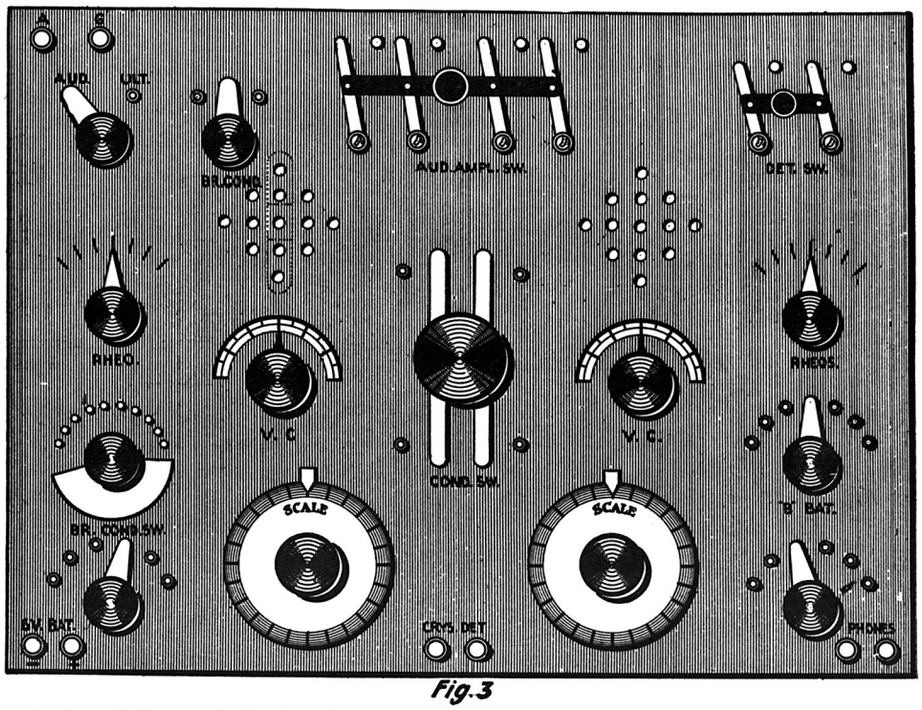


Fig. 3

Design of the panel showing the well balanced arrangement of the various switches, scales and binding posts. Note the vent holes for the Audions.

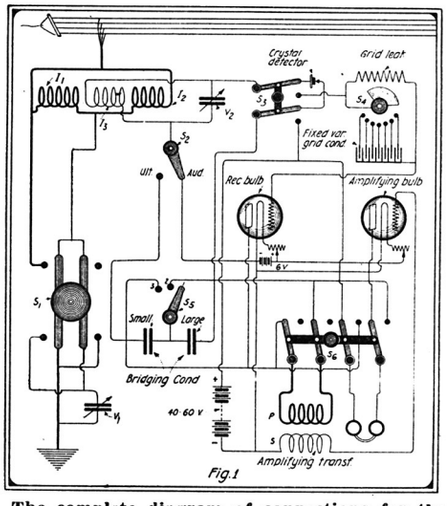


Fig. 1

The complete diagram of connections for the cabinet receiver. Note that two primary coils are employed with secondary.

two bridging condensers. These two condensers are of different capacities, the larger one being made of three sheets of tinfoil 4 x 10 inches, separated by sheets of waxed paper. The smaller one is made of two sheets of tinfoil of the same size. When the switch S_5 is thrown on point No. 1, the two condensers are connected in series, which is the lowest capacity obtainable. When thrown on point No. 2 the small condenser is in the circuit, and when thrown to No. 3 the large condenser is in; thus three distinct capacities may be obtained.

S_6 is the switch for using either the audion circuit lone or throwing in the amplifier. When thrown to right the phones are connected to the plain audion circuit, and the amplifier is automatically cut out. When thrown to the left the phones are hooked up to the amplifier which is then in the circuit. In this way the entire circuit can be quickly changed by one adjustment only.

The amplifying transformer is of the two-coil type offered for sale by several manufacturers. However, should the amateur desire to build his own transformer it can be done as follows: Wind 3,000 turns of No. 40 enameled wire on a iron core ½ in. in diameter and 1½ in. long. Tape this winding and over it wind 12,000 turns of No. 44 enameled wire. Boil the entire unit in paraffin and tape.

The grid leak which is shunted across the grid condenser is made by drawing a pencil line ¾ inch long on a piece of paper. Experiment will show the correct thickness of this line.

The two audion bulbs should preferably be of the new *highly evacuated* type developed during the war. This type of bulb is very efficient and, in contrast with the ordinary gaseous bulb, requires no critical adjustment of the potential of the "B" battery. The older type bulbs may be used, *but it must be remembered that the receiving bulb must be a good oscillator. The entire success of the outfit as a continuous wave receiver depends on this.*

The high and low voltage batteries are hooked up as shown, using a storage battery to supply the 6-volt current and a series of flashlight cells to furnish the 46-60-volt potential. An amateur of limited means who does not care to spend considerable money for flashlight cells may make his own high potential battery as follows: Fill twenty-five test tubes with a paste made of manganese peroxide and powdered carbon which has been moistened with zinc chloride and sal ammoniac. Place a zinc strip and a carbon rod in each tube and pour melted paraffin over the top. These cells connected in series form an excellent battery which can easily be renewed by removing the paraffin and remoistening the mixture with sal ammoniac.

The audion bulbs may be mounted either in front or inside the cabinet, the latter way being preferable as it protects them from breakage. If a second audion bulb is considered too expensive at first, build the outfit, hook it up as shown and leave a place for the other bulb to be obtained later.

In conclusion let me say that the set herein described is remarkably inexpensive and capable of doing exceptionally good work. There are only two variable condensers used; no expensive and cumbersome undamped loading coils are employed, and the same set of "B" batteries and filament cells are used for both audions. Construct the complete outfit and the results obtained will amply repay you for your time, labor, and expense in building it.

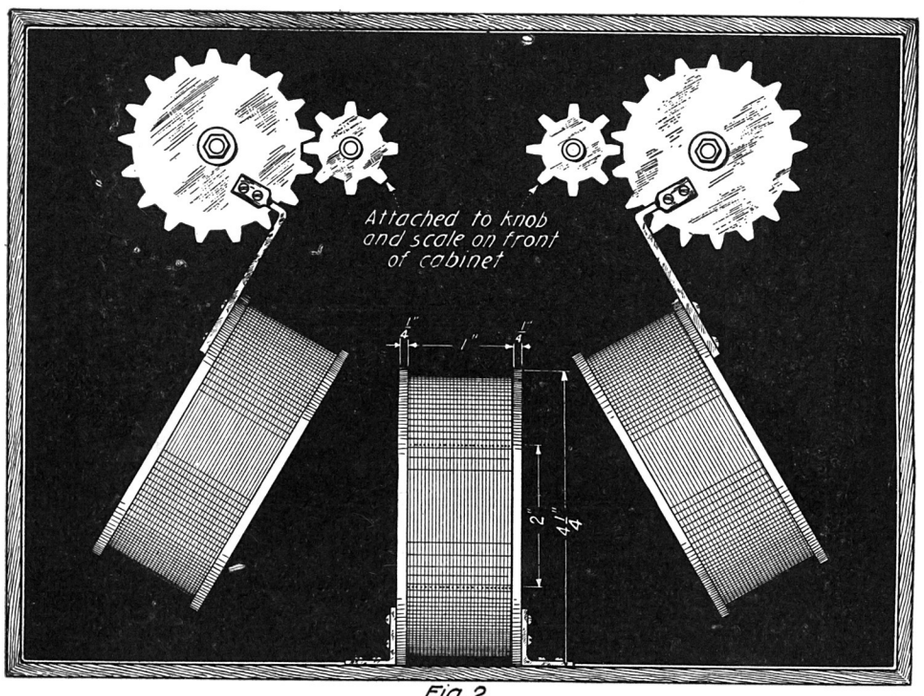


Fig. 2

Dimensions and mechanical coupling arrangement of the three inductances. The secondary inductance is stationary while the two primaries are adjustable.

San Diego, Cal., from London

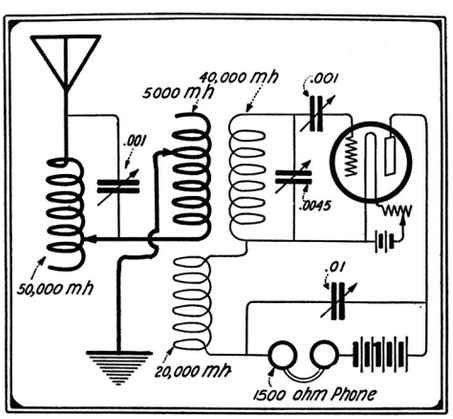
By ALEXIS J. HALL*

This scheme for long range reception was evolved by the writer after a considerable amount of experimental work, and results obtained would appear to "justify the writer's assertion" that further experiments may yield even better results.

The aerial used was of the "L" type, composed of four strands, each 7/23 (B.W.G.) stranded bare copper wire, elevated at the highest end to 125 feet, the lead-in being taken from a height of 90 feet, the top span length being 650 feet.

With the apparatus specified on attached sketch, and *one valve* only in use for reception, the stations in America were audible at the strengths stated, strength 7 being taken as the standard of clear reception with strength 3 as the basis of a signal readable by an expert:

San Diego	Strength,	3 to 4
Great Lakes	"	3
San Juan	"	6
Belmar	"	8 to 9
Sayville	"	8
Arlington	"	8
San Francisco.....	"	4
Key West.....	"	5
Balboa	"	7
New Orleans	"	5



Here is a hookup worth trying out. Note the different inductances and capacity values are given.

Practically all the above stations were using arc for transmission and were heard at the strengths stated during daylight. No amplifiers whatever were used.

* Radio Engineer Alliance Aeroplane Works, Acton, London W. S.

TRANSMISSION THRU EARTH AND WATER FOUND SUCCESSFUL

San Diego, Cal.—Radiography will be revolutionized by transmission through the earth and water, instead of the air, as the result of discoveries made at a little experiment station on a barge in San Diego Bay, it was predicted by Lieutenant R. A. Morton, of the Navy radio laboratory at Mare Island, who conducted the experiments.

First proof of the success of the new method of radio transmission through the earth, according to Lieutenant Morton, was made when the Navy Department sent a message from the Annapolis station to the British admiralty that the dirigible R-34 had been sighted off the American coast. Lieutenant Morton was at his instruments, heard the message and copied it in its entirety. He said that under-water cables can be pointed like a gun toward any station desired and so single out such a one, whereas, aerial antennæ are equally affected by waves from all directions. The signals received were of the same audibility as intercepted by the overhead antenna.

How Manufacturers Work "Formica" and "Bakelite"

By J. STANLEY BROWN*

OXYBENZYLMETHYLENGLY-COLANHYDRIDE" is the chemical name of that wonderful insulating material — "Bakelite." It is non-hygroscopic, the best insulator known, will stand a heat of over 400 degrees centigrade before carbonizing, and is practically unbreakable. The layman gets this compound in the clear amber color that is one of its characteristics, when he buys a cigarette or cigar holder. Even umbrella handles are made from it. For use as a commercial insulator the compound, still in the molten state is mixed with paper pulp and allowed to harden and form "Bakelite Dilecto". Also it is mixed with different body materials and moulded under pressure to form the various moulded insulating parts so much used in the world today. Receiver caps, instrument knobs, switch handles, commutator settings and many other items are made this way.

It is well known, of course, that "Bakelite Dilecto" in the form of sheets, rods and tubes, is the standard in both government and commercial apparatus for insulation purposes. It is rapidly coming into its own in the amateur radio field.

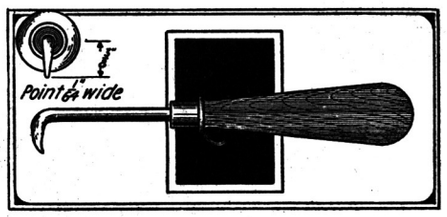
The proper use of "Bakelite" and "Formica" seems to be a mystery to the amateur and many professionals as well. It can be secured from the manufacturers in either the natural brown color or in black. A great deal of government receiving apparatus makes use of the brown and it is then given a polished finish by means of fine grade tripoli and an ordinary buffing wheel. Black "Dilecto' is in predominance and is generally finished in dull black or what is known as the grain finish. Polished black surfaces of "Bakelite" are being abandoned in favor of the grain finish, as they look rather shiny and cheap.

The question often asked is, "how can I finish this stuff except by hand?"

The answer that will be received from the manufacturers of either "Formica" or "Bakelite" is, "even the largest users of our products secure the fine grain finish by means of fine sandpaper and oil and handrubbing. No mechanical method seems to give the proper result. For the final finish rub with a fine grade of rouge and wipe with an oiled rag." The above process gives a fine appearance, but the writer has succeeded in finding a mechanical means to do the job and it is giving daily satisfaction in finishing hundreds of panels, large and small.

To begin with a cloth wheel is built up and balanced. It should be about 12 in. to 16 in. in diameter. Now mix some very fine emery with a binder and apply the mixture to the wheel. Be sure to secure a very smooth and uniform coating. A regulation grinding and polishing lathe is now belted down to a speed of about 400 r.p.m. The wheel is locked in place and a coating of machine oil is applied to its surface. The surface to be finished is applied to the wheel with a regular and steady downward motion. The chief difficulty seems to be in getting under the skin. After that it is easy to work out the scratches and the brights. This method, of course, would not pay the average experimenter for the time it takes unless he is after production.

The best way to finish the edges of panels is against a fine sandpaper disc. It is well to make sure that the table is at true right angles with the wheel. The final finishing is always given with an oiled rag, as stated before.



This shows the construction of the tool used for working scales, etc., on bakelite.

Cutting, Drilling and Tapping

The average amateur has the "blues" after his first attempt to work "Bakelite" or "Formica". By the time his work is finished he has a nice pile of broken drills, hacksaw blades and taps. The tendency of the substance is to resist any cutting action so that it does not do to force the work, as it will quickly draw the temper out of the best of tool steel. Drills should be driven at moderate speed and sharpened frequently; *if not each hole will be a little smaller than the one before.* Grind the drill with good clearance and use a rather coarse feed. Drill all holes from the finished surface *as the drill always breaks through, leaving a ragged hole.* When drilling into the edge of a "Dilecto" sheet a clamp should be applied to the faces at the spot to prevent splitting. This is a necessity when tapping from the edge.

It is customary in tapping to use a size smaller drill for a given tap than would be the case in metal; this will assure good clean threads.

When cutting the substance on a small basis, a hacksaw with a rather coarse blade is resorted to. Firm, steady action of the saw is assured if sufficient pressure is applied and one does not attempt to "speed up". When cutting in large quantities and to irregular shapes a specially tempered band saw, driven at about half the usual speed, is used. Here again let me say that extra production does not result from forcing the machine.

When straight cuts are to be made a metal-slitting saw is the best thing to use. If possible it should be ground just beneath the teeth to give it set.

Machining

When turning, a tool with a large tungsten content should be used. The lip should have a positive rake and be slightly above the center-line of the work. When using the "Dilecto" rod one will find that it works much the same as fibre. Many times discs are turned out of the sheet for the purpose of inductance caps, rotary spark gap wheels, etc. They are first cut to approximate size on a bandsaw and accurately machined in a lathe by mounting in groups on a mandrel. The last disc should always be backed up by a brass plate, to prevent extreme burring of the outer edge. Surfacing cuts should be avoided if possible, as it is difficult to do a workmanlike job.

Milling

Milling is one of the best ways to work the substance and cuts should be made at about the same speed as if one were cutting cast-iron. Always back the work up with a brass plate when cutting across the grain. Never use oil or any form of lubricant when machining "Bakelite" or "Formica".

Stamping Letters and Engraving Scales

Anyone who has ever taken letter or number stamps and tried to mark posts or terminals on "Bakelite" has become very disgusted, without doubt, and has begun to believe that "Bakelite" and glass are in the same family. It is quite likely that nothing resulted but a rough-looking hole in the surface of a fine new panel.

When a particularly fine job of marking is desired, it is the custom to have it done by an engraver. However, the scales and letters on most all government and commercial apparatus are stamped on. You say, "How?" Well, the panels are placed in a vat of boiling water until heated through and through. They are then laid on a table and *stamped while soft.* The burrs raised up are then pushed down with the face of a carpenter's hammer. After the water has been wiped off and the panels have become perfectly dry the depressions are filled in with thick white lead. After this another application of the oil rag will give a finished piece of work.

The above method of marking scales is all right from a production standpoint, but the amateur is obliged to employ a different means. The writer has used the following method with considerable success.

First secure a piece of No. 18 (Stubbs' Steel Wire Gauge) drill rod about three inches long. Bend at right angles 3/8" from the end and grind as shown in Fig. 1. Mount in a small wooden handle.

The scales radius and sub-radii are now laid out on the panel, after the finishing is done, with a draftsman's lead compass. The inner radius should be scratched in deeply with a pair of toolmakers' dividers. Now clamp the panel to the bench and use a combination square to guide a protractor of the draftsman's type and lay off the points with a sharp but soft lead pencil. If a patented protractor is at hand it will not be necessary to lay out the scale, as it can be scratched in by using the protractor arm as a guide. If not, a pin is driven into the center and used as a guide in connection with the pencil marks. The 10 degree marks should be 1/2" long, the 5 degree marks should be 3/8", and the single marks about 1/4" on the ordinary scale.

After scribing the scale in place the burr

(*Continued on page* 259.)

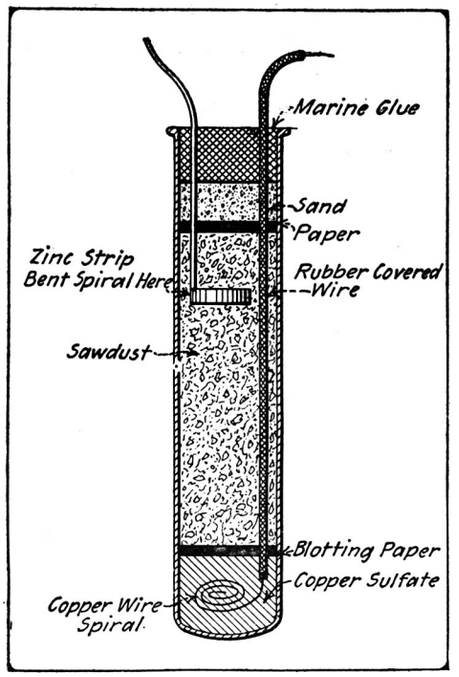
*Radio Engineer, Menominee Electric Co.

Improved "B" Battery Construction

By JOSEPH G. REED

Running an up-to-date audion radio set in these strenuous times is no joke, believe me, with raw material at such a high figure, and in this article I intend having a mighty hard go at reducing the H. C. R. (high cost of receiving), as far as the high voltage "B" battery is concerned.

From descriptions in many wireless magazines the test tube storage battery appears to receive a lot of favor—at least theoretical—from experimenters because of its simplicity, and low cost. I past thru this stage in my radio evolution, but discarded the idea as too costly after ruining a uniform, and other articles which were unfortunate enough to come in contact with the H_2SO_4. A dry battery seemed about the only alternative, and to get over its high initial as well as maintenance costs I evolved the following types of cells:



One type of battery which has proved very efficient in the plate circuit of an audion.

No. 1 employs a construction I have not yet seen mentioned in radio circles.

It is a miniature of the Minotto cell, which is a modification of the Daniell cell. I first thought of the idea after reading Mr. Thomas Reed's article on "Bats."

For a 50-volt battery procure 50 test tubes 1" x 6", 25 yards No. 18 B. & S. rubber covered copper wire, 1 sq. foot sheet zinc, as used for dry batteries, 2 lbs. of copper sulfate, marine glue and sawdust.

A section of the battery is shown in Fig. 1. Cut up the wire into 15" lengths, have 6" and remove tinning with emery paper, then form into a spiral as shown. The outer binding, etc., must be removed from the rubber insulations or it will cause trouble later thru capillary action if left on. Bend the spiral at right angles, place it at the bottom of the tube and cover it with 1" of powdered dry CU SO_4, add a little water to just make damp and then cover with a layer of felt or blotting paper. On top of this pack 3" of damp sawdust which has been previously thoroly soaked and cleaned in water.

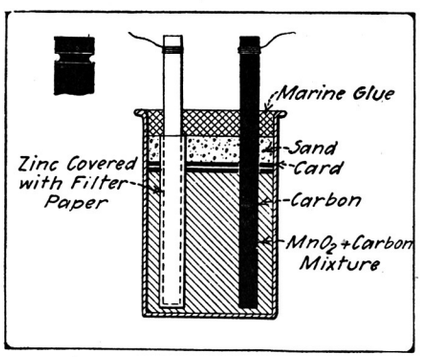
Now cut a strip of zinc sheet 9" long by ¼" wide and form it as shown in the drawing.

Insert it on the top of the sawdust and pack on some more of the latter to within ¾" of the top of the tube. Place a layer of paper on top of this, then pour in some sand to within ¼" of the top, and finally seal with marine glue or sealing wax. To make a water-tight seal run a hot iron around the top of the tube to stick the glue to the glass. The voltage of this cell is 1.06 volts, and it can deliver a maximum current of about 20 milliamperes for a long period. Its internal resistance is in the neighborhood of 50 Ohms. As the current taken by the audion is measured in microamperes, this type of cell will easily deliver all the current required.

If the copper sulfate shows a tendency to work its way up thru the sawdust, it can be brought back to its proper place by short circuiting the battery for about an hour. This will not injure the cells, as they will discharge continuously without appreciable diminution of output under these conditions for several days.

Because of the fact that these cells deteriorate if shaken about or held in any other position than the vertical, I developed a more stable variety fashioned after the regular dry cell.

To make a 50-volt battery procure forty (40) small bottles of the type used by druggists to pack vaseline, etc., 10 ft. of ¼" zinc rod, 10 *plain* arc carbons 30 mm x 6mm, and sufficient manganese dioxide, carbon powder, sand, and marine glue to fill and seal the cells. Cut the carbons and zincs into 3" pieces, and around the zincs wrap filter paper to a height sufficient to prevent contact with the manganese dioxide mixture. Local action will ruin the cell if the zinc is allowed to come in contact with the depolarising material. Prepare a sufficient mixture of 60% MnO_2, 40% carbon powder, to fill all the cells, and make into a paste with a 20% NH_4Cl (ammonium chloride) solution. Fill the pots to within ½" of the top, moisten the paper around the zinc with NH_4Cl solution, and insert it and carbon in opposite sides of the cell. Cut a small piece of card, as shown, place on top of the mixture, and pour in a ¼" layer of clean dry sand. Seal the cell with marine glue, taking great care to make a water-tight seal, as previously explained, or creeping in of ammonium salts will be very troublesome. All the cells should be connected in series by tightly twisting pieces of copper wire between the zincs and carbons, and finally the tops of all cells given a liberal coat of paraffine wax to prevent corrosion or accidental short circuiting.



Another type which is more stable and produces even better results.

The open circuit voltage of these cells is 1.5 volts, and internal resistance 10 ohms. Under working conditions on an audion circuit taking 700 microamperes for a continuous period of six hours, a 50-volt battery of this type had an average voltage of 1.35 volts with less than a 2% variation between initial and final voltages. As these cells are absolutely evaporation proof they last for a very long time before having to be recharged with fresh materials. I have had one set working on a load of one milliampere for at least two hours per day since January, 1919, and the lowest voltage reached at the end of a run has been 1.26 volts. In conclusion I would like to invite correspondence from any reader who has developed any portable audion "B" battery.

Practical Suggestions on Oscillating Audion Circuits

By C. C. HENRY

THE advent of amplifiers in the general radio field makes necessary certain precautions being taken to prevent undesirable noises offsetting the advantages of amplification. Many, somewhat inexperienced in regenerative reception in conjunction with one or two stages of audio frequency amplification, are at present designing elaborate receiving panels without due regard to the necessity of keeping sliding contacts out of the design only where necessary; and the desirability of making every connection a soldered one. All leads in the amplifier circuits should be kept short and, where necessary, cross each other at right angles. The transformer coils should be placed at right angles as well. Amplifiers sometimes show a lesser tendency to "howl" when the leads between the detector tube plate circuit and the primary of the audio frequency transformer are reversed. In receiver circuits, other than those used for direction finder work, it is possible to directly ground one side of the filament lighting battery. This usually removes all tendency to "howl", as well as much induced hum from A. C. and D. C. power and lighting circuits; but does not decrease signal strength. All A. C. and D. C. lighting and power circuits and perhaps telephone lines adjacent to the receiving set should be metallic covered, and this metallic covering grounded, if "induction" is troublesome. If drop cords near the receiver are desired they should

(*Continued on page* 254.)

Ideas—Second Spasm

By THOMAS W. BENSON

Really, the demand for ideas is past all supply, judging from the interest shown in my little Bridge Circuit, not to mention the kind assistance of Zip. Just between you and I, dear reader, that lamp stunt worked, didn't it? 'Fess up.

Now, here is a couple more; let's see what we can get out of them. Look at the average loading coil or inductances used for long waves. Inches, feet, yards of darned expensive wire wound on big tubes that take up the room that should be used or available for storage of, say, coal, hay or other fodder.

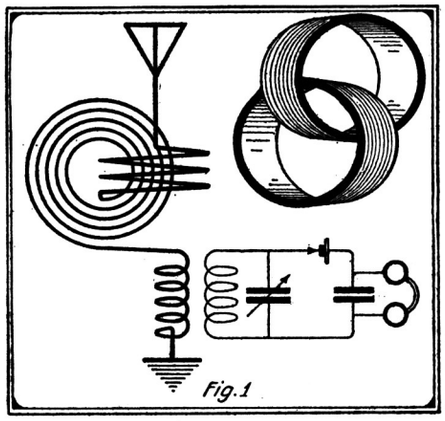
Why not devise a core that would enable a tiny coil to tune the longest wave? In the good old days I've loaded 2500 on an 800 coupler with twenty feet of wire around a finishing nail, no fooling. The new core, of course, should have low hystersis, which condition can be obtained by having the molecules of the iron in a state of poor equilibrium. But how? Well, try this. Wind two coils of iron wire in the manner shown in Fig. 1, using one layer of wire in each coil to cut down capacity losses.

Now, we know that a field of magnetic flux surrounds a wire carrying a current, and that field starts from the center of the wire and spreads; this accounts for inductance in a straight wire, the field of flux cuts some of the conductor while spreading from the center outward.

Carrying on, consider our coil in a circuit, as shown; as soon as current starts to flow that flux field starts to build up in each coil, the molecules in the iron of both coils are loosened as it were and respond quickly to the influence of the other coil. Will it work? The hystersis is cut down, no choking, or is it?

"I'll have another cigarette, thanks!"

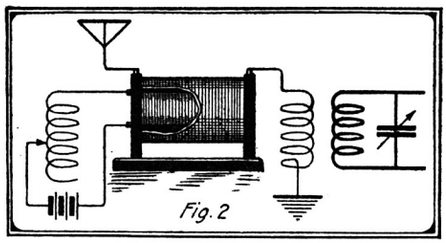
But then there are other ways of upsetting the equilibrium of molecules in iron. We are all aware of the fact that *iron loses its magnetic properties as its temperature increases* up to the critical point where it ceases to be magnetic.



The Coils Shown Here Are Wound With Iron Wire Instead of Copper.

Ha! Chain that idea. Let's see. Take a piece of mica and roll it around a form about an inch in diameter. Take a long length of iron wire, *double it* and wind it closely on the mica, but do not let the turns touch. When in place the wire is plastered over with alundum or asbestos cement and covered with a second sheet of mica.

The non-inductive heating unit is used to form a core for an inductance coil. When everything is hooked up connect the core to a source of current properly controlled by a rheostat.



Here We Have a Combination That Can't Be Beat.

It should work then in this fashion: The current heats the iron wires and puts the molecules into vibration, any radio currents flowing through the coil will have little difficulty in swinging them one way or the other, as per existing theories of magnetism. Lo, we then have a core *with the hystersis under perfect control,* mighty handy to warm the hands on in winter, to keep the radiator in the car from freezing or heating wifie's curling irons, too. Or, mayhap, to marcel the waves!!

Hey—wait a minute! Here is another idea along the same lines. Iron is not the only substance that is magnetic. An alloy of 60 per cent copper, 14 per cent aluminum and 26 per cent manganese is highly magnetic. Let us then try various percentages of these metals to form a new alloy that will increase the inductance of tuning apparatus without choking the signals.

They should be formed into a tube and the wire wound on a second tube somewhat larger to prevent capacity losses—or why not wind the coil with wire made from the alloy in layer windings, one winding forming a core for the next, and so on? Let's see, what shall we call the alloy? Er—how about—all right, Mr. Editor, if you insist, here's your copy. Au revoir, Idea-ists, I have some more detectors I'll tell you about later.

Curtain—Please.

(39th Associate Editor's Note.—This bird Benson sure is unromantic and naive as a new-born pterodactyl. Here he goes—see Fig. 2—and builds an honest-to-goodness audion—loose coupler combined—hot filament grid—and plate, and never tumbles to it! It only remains to place the contraption amidships of a vacuum—let us say the inside of a vacuum bottle, replace the cork, and off you are!!—"Fips.")

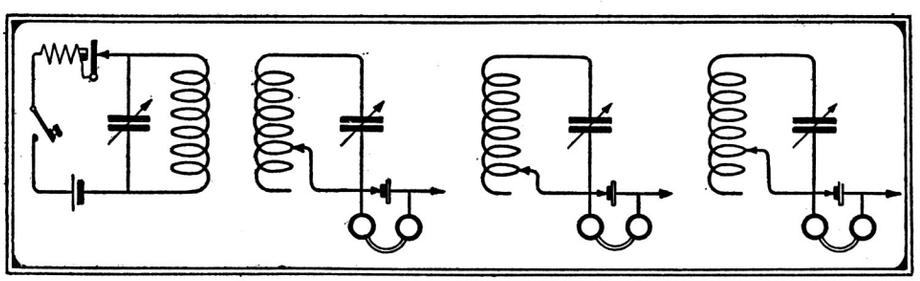
Practical Method for Instructing Code and Tuning

I believe that if the following system is used by Radio Clubs in their efforts to teach aspirants to be good radio operators, that it will be found a very effective method since it simultaneously gives tuning and code instruction. The advantage of such instruction is obvious.

The only instruments necessary are an inductance, a buzzer giving a high-tone, a variable condenser, preferably of .001 mfd. capacity, a telegraph key and a dry cell.

The inductance will give a range of wave lengths from 200 meters to 600 meters approximately, when shunted by a .001 mfd. capacity. It is constructed as follows: A cardboard tube 3½ inches in diameter and one inch long, is wound with twenty turns of No. 25 double silk-covered wire with connecting leads of 6 inches. When the inductance is made it should be connected in a circuit as the diagram shows.

It can readily be seen that the system is merely employing a wave meter as a transmitter of signals. The whole apparatus may be mounted in a cabinet or box, the design of which I will leave to the constructor, because of the various conditions that surround each individual case. Above all, the buzzer should be muffled. Receiving sets made up of detectors, variable condensers and receivers, should be brought into use with this method of instruction. I have found from experience that if only a straight inductance is used in the receiving, better results are obtained in sharpness of tuning when the unilateral connection is employed.



By Using a Buzzer Transmitter Several Receiving Sets May Be Used for Instruction in Code and Tuning.

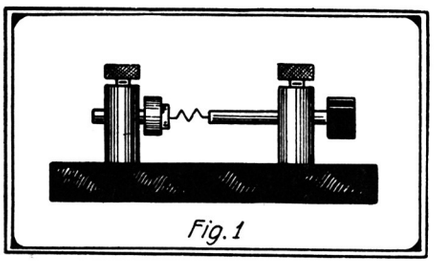
I will leave it to the ingenuity of the code instructors for different methods of using this system. Of course the builder of this apparatus is not limited only to the small inductance described.

Contributed by
Wendell King.

"Notes on Crystal Detectors"

By C. H. BIRON

In this day, just as of old, the layman goes through the period of his apprenticeship using the crystal detector in preference to the more expensive and complicated vacuum valve.

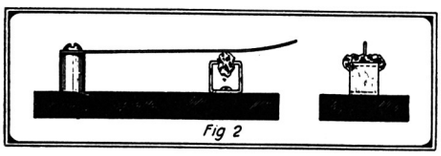


A very efficient galena detector design. Note the rigid construction.

He is favored less, however, than the "Bug" of other days, inasmuch as the ground that he must cover is but occasionally touched upon by the substance of the current press.

The aim of this article is to bring out a few points of construction in a general way with a word or two anent the safeguarding and operation of crystal detectors.

As the jarring out of adjustment is a consideration that should be anticipated in designing of the device, it will be considered first. Briefly speaking, a design which best overcomes the effects of jarring and all ordinary vibration is one in which those parts not rigid with the base are so light



This type of construction is best adapted to a silicon detector.

as to be carried freely with the slightest motion given the device.

These qualities are instantly apparent in the galena detector shown in Figure 1. There is nothing new about this particular form, but it illustrates the point in question very well as all the parts are rigid except the fine wire contact, which is so light as to offer practically no resistance to any vibration transmitted to it. The smooth surface of galena is adaptable to this form, as it permits the contact points being moved over it with the point of a pencil. The rod holding the wire being tightened at a point that gives approximately the best working pressure.

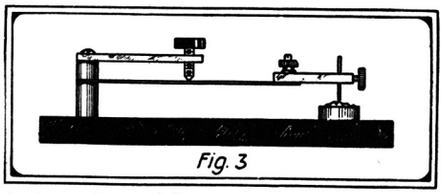
Another style that involves the same principles is shown in figure 2. This pattern is a variation of the so-called "catwhisker," and as the length of the spring wire contact requires some size and moderate pressure, it is a very satisfactory mount for silicon which ranks a close second to galena for sensitivity.

Either of the foregoing types will remain in adjustment for days at a time where they are subject to the ordinary jarring that works havoc with the setting of many other types. Tho they are but two of many ideas that embody the same virtues, they will give very good results when mounted on receiving panels, on bases with tuners or other apparatus, in portable sets or, in fact, any location where the processes of tuning impart vibration to the whole.

By way of contrast an opposite extreme is shown in Figure 3. Here the contact carrying arm will rebound with vertical vibration and undergo tortion with sudden motion in a horizontal plane resulting in microphonic noises in the headset and loss of setting.

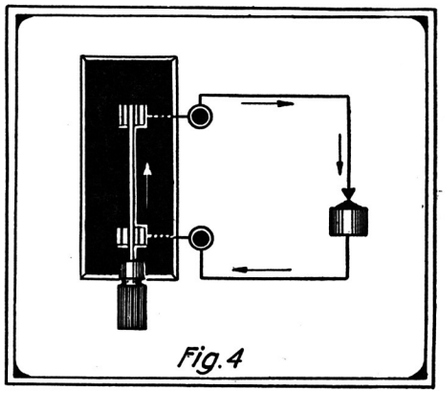
Detectors that employ comparatively heavy pressures, such as carborundum and zincite-bornite couples, do not require much delicacy of design, and nearly any type of stand will suffice for their use.

Another annoyance common to crystals is the burning out of a sensitive spot thru strong signals or the effects of the local transmitter. A very common error in correcting this evil lines in "shorting" the detector while sending. A glance at Figure 4 will show that this procedure defeats the purpose intended as the detector then forms a closed circuit in itself, the size of which depends on the physical arrangements of the parts that make up the loop. When in proximity of the transmitting circuit this loop is traversed by a current that is governed by the plane of the loop in relation to the conductor of the transmitter and its nearness to them.



Carborundum and other minerals requiring heavy pressure should be used in a stand of this type.

The best procedure in safeguarding the detector while sending is to disconnect both sides of it from the circuit as close to the device as is found practicable. It is also well to cover it with a metal box or a non-metallic cover lined with tinfoil, which may be set gently over it after adjusting. This cover will also preserve the mineral by shielding it from grease and dirt.



This method should never be employed. The Shunting of a detector with a switch forms an oscillating circuit.

Increasing the Secondary Voltage of Your Transformer

By F. E. TERMAN

Stanford University, California.

Many amateurs have not obtained full efficiency from their transformers in the past, due to the fact that tthe transformer had a secondary voltage that was too low to enable full power to be obtained on two hundred meters with the small condenser necessary to obtain this wavelength. By examining the following formula, this fact will be made clearer:

$$K.W. = \frac{\text{Frequency} \times (\text{Sec. Volts})^2}{C\ (\text{mfds}) \times 10^9}$$

For example, take a one half kilowatt transformer having a secondary voltage of 7,000, with the rotary giving a frequency of five hundred cycles, and apply the formula. In doing so one finds that the maximum power that the condenser will handle is about a quarter of a kilowatt, and while the transformer is efficient for the power consumed, as the primary will only draw a quarter of a kilowatt, still the transformer is not giving all the power that it was designed to deliver, and no enterprising amateur is ever satisfied with such a condition. Since there are practical limitations to the speed of the rotary spark gap, and the condenser capacity is fixed, the only way in which the power can be increased is by raising the secondary voltage of the transformer. One way to do this is to feed the primary about 180 to 220 volts. This voltage can be obtained from a power transformer working on 110 volts, altho this is a rather expensive method, or if the house is wired with the three wire system, the two outside wires will give 220 volts, and in conjunction with a choke coil will solve the problem very nicely. In most cases, however, it will be easiest to tap the primary of the transformer, thereby reducing the number of primary turns, until the desired secondary voltage is obtained.

To do this it is necessary to unwind the insulation around the primary for a width of about a half an inch, until all of the layers of the primary are exposed to view on one side. Then one of the end wires of a layer about a third of the way from the outside should be pulled slightly out of place, the insulation removed for a short space, and a tap taken off by soldering the bared end of a piece of flexible conductor, as a lamp cord, to the wire. If additional regulation of power is desired, another tap can be taken about one sixth of the way from the outside. This will approximately double the voltage, so that in cases where the voltage is to be raised only about thirty percent, one would obviously take the taps off nearer the outside edge, or else a very large overload

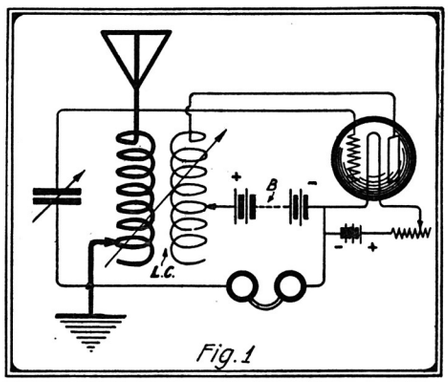
(*Continued on page* 258.)

Some Valuable Tips Worth Trying

By J. W. F. CHIPMAN

MANY amateurs will doubtless count as valuable the few little innovations and ideas herewith presented. Some of them were used constantly by the writer while in France with the Canadian Corps, and others of them are in operation now at his station.

Instead of considering the old fashioned (?) loose-coupler good only for experimental work on spark reception, one can use it with no change whatsoever made to it for receiving spark and continuous wave station signals. In the accompanying hook-up (Fig. 1) L. C. denotes an ordinary loose-coupler, the secondary coil of which is in this case a "tickler coil", being connected in series with the plate of the vacuum tube. Regular readers of the RADIO AMATEUR NEWS may have noticed this diagram in the September issue. It was there accredited mistakenly to the French radio service, whereas the circuit was devised by a Canadian wireless operator, after a lot of experimenting with different connections, forms of inductances and battery voltages. The variable condenser shown can be omitted, for altering the coupling of the two coils will bring about the same closeness of tuning. The primary taps should be of the units and tens variety for sharpness of tune. The voltage of the B battery should be not greater than 75 and not less than 15; in France we used a dry-cell battery with voltage taps taken off every 15 volts. With the hard (exhausted) type of valves, six volts may be required in series with a small variable rheostat made of about ten feet of good resistance wire wound in the form of a spiral, while with soft valves four volts should suffice to light up the filament.



A new circuit to be tried out by you amateurs.

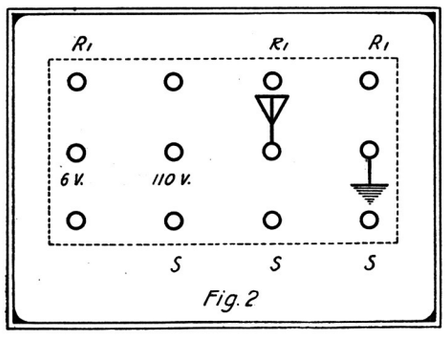
The cost of accumulators may be somewhat prohibitive for some amateurs, particularly where their use entails the purchase of a rectifier for charging them. On that account some experimenting was done and it was found that just as good results were obtained using ordinary wet cells as by lighting tthe audion filament with storage battery juice. The best type, and perhaps as cheap as any, is the common carbon-cylinder, zinc-pencil cell, using sal-ammoniac solution for the eletrolyte. There are no noxious fumes from this type of battery, and they will only require attention about once in three weeks, when the solution should be renewed, and the elements and containing jar be thoroughly cleaned. It is most important, however, to have the zincs well amalgamated with mercury, otherwise the cells will quickly run down when lying idle, by reason of the zincs becoming eaten through.

A great saving in the time of operating, in space, and in expense, can be accomplished by having all your double-throw switches mounted in such a way as to have a 90-degree throw instead of the usual 180 degrees. The writer has all such switches fastened on a board at right angles to the top of the operating table, so that half of the contacts are mounted on the table, and the other half on the board, the knife-blade hinge being in the corner. Instead of going to the expense of buying double-throw switches, why not buy the single-throw variety, and either make or else buy (they are easily obtainable) the opposite contacts.

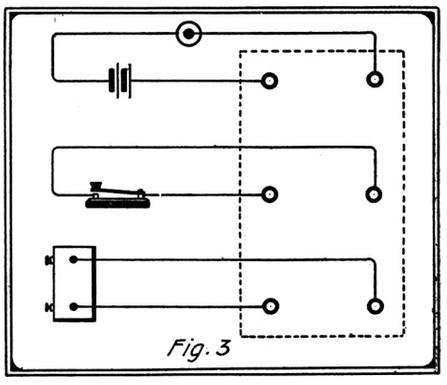
For stations using the supply mains, and also having audion reception, it is advisable to have a quick change-over switch which will make or break several different circuits. The four-pole double-throw switch represented by Figure 2 will prove a handy arrangement for this purpose. No explanation is necessary of this, for it can be seen that in changing from send to receive, the supply main to the key and transformer is broken, the aerial and the earth thrown to the tuner side, and the filament current circuit of the audion is made.

Instead of having the test buzzer circuit closed, as is usually the case, by a push button located on the table top or on the panel, it is far better to do away with the push and arrange two metal contacts in such a way as to be able to close them by pressure of the knee sideways against the leg of the table or other support. By so doing, one can get at his crystal detector with both hands to recover that sensitive point.

In Figure 3 is shown an arrangement made possible by a double-pole, double-throw switch, whereby the sending key may be used for practicing, with a loud buzzer and battery in series. On the throwing over of the blades of the switch, the key is in circuit with the sending transformer and the mains.



Connection for a change over switch.



Arrangement for utilizing buzzer for practice.

Your "Fist"

By C. H. PFEIFER

WITH the approach of the time when amateurs will resume operation of their transmitting sets comes the itching to get that key under your fingers once more, to jazz out your thoughts to your friends far and near.

But are you one of that ostracized class who, although old hands at the radio game, are still referred to covertly by their fellow operators as "hams", either because of a disinterested style of sending or its other extreme, too much swing or as one might say, jazz? If so, then for the sake of your own popularity during the coming days of competition, you had better turn your introspective eye and ear on your fist, and analyze it with a view to improvement.

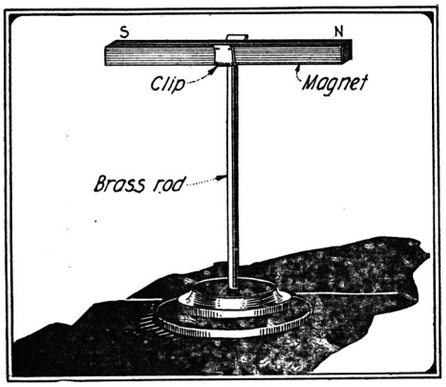
There are almost as many styles of sending as there are operators. The requirements for the ideal fist are a reasonable speed, legibility, and—mark this—individuality; and while the first two are of great importance the latter will make or break you no less. Any one who has listened to automatic tape transmission, which is perfect Morse, knows how monotonous this becomes after a short time. Why? Because the human touch is lacking and the sending has lost its individuality. It is too perfect.

The other extreme, the affectation of an exaggerated swing, has its drawback in loss of clarity and speed. Since a swing is the assertion of the operator's individuality, it is not well to discourage it altogether; but beware of its exaggeration, for when too amply cultivated it becames as rasping as the cheaper popular song heard several times and then tired of. The writer has been vastly amused more than once by hearing amateurs in the developing stage

(*Continued on page* 258.)

USING A PERMANENT MAGNET WITH THE AUDION

Very few articles have been published concerning the use of a permanent magnet in connection with the three element vacuum valve. Some of them state that



Method of mounting the magnet.

the signals are greatly intensified while some say the opposite. After experimenting for some time I have found that the permanent magnet is an accessory worthy of a place upon the operation table.

If the rheostat is left slightly under the best point of adjustment and a magnet of the permanent type moved toward it at about the heighth of filament, the election discharge will be varied by the influence of the magnetism until a point is reached where the intensity of incoming signals of a certain station are loudest. The polarity of the magnet will make quite a difference in the intensity of signals, one pole usually bringing in some signals louder than the other.

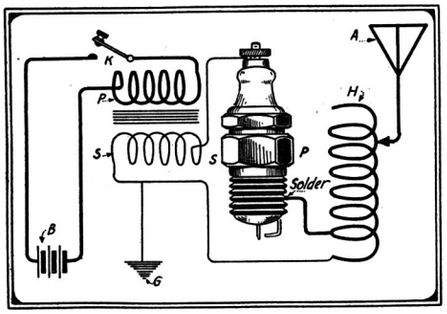
The magnet may also be used to reduce interference, its manipulation being much more accurate than that of the other receiving instruments.

A convenient stand for magnet is shown in the sketch. It consists of a wooden base slightly larger in diameter than the length of the magnet, a brass rod, and a springy brass clip. The base is made large, to prevent it from toppling over. If this is to be used on a cabinet where the bulbs are inclosed, the base can be made smaller and weighted by drilling holes in the bottom and filling them with lead. This will allow the magnet to pass through the "peep hole."

Contributed by H. KARIG.

SPARK PLUG FOR SPARK GAP

Now that we are permitted to transmit once more, those of us who have an old discarded spark plug hanging around can make good use of same as shown in the drawing.



Hookup for using a spark plug as a spark gap.

I have found this to work very well on small coils and also for amateurs of limited means. The plug can be an old one, and it works as well as when new, that is, if the insulation is O. K.

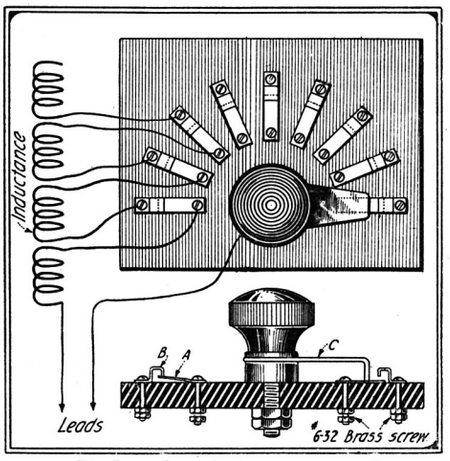
Contributed by T. G. WINDOM.

"DEAD-END SWITCH

Here is a design of "dead-end" switch, which I think is even simpler and less expensive than most switches of this type.

A is a piece of thin spring brass about a quarter of an inch wide.

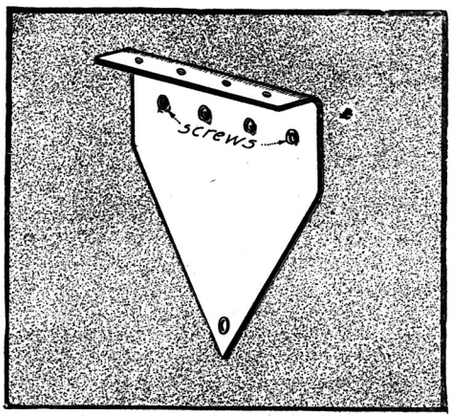
B is a piece of stiff brass a quarter of an inch wide and bent into the shape shown.



Dead end switch arrangement.

The switch lever *C* should be somewhat heavier than usual, so as to depress the spring *A*. The turned-over end should be well rounded in order to slide upon the piece *A*.

As shown in the accompanying rough sketch, when the lever *C* makes contact with *A*, the remainder of the inductance is entirely disconnected. (*Contributed by F. S. Williams.*)



Showing the construction of the aerial connector.

AN AERIAL CONNECTOR.

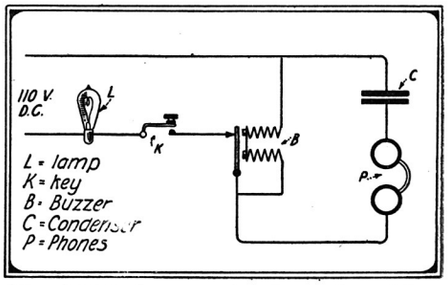
The material necessary for this antenna connector are:

A small piece of 1-16" sheet brass, five (or more) machine screws ⅜ x 14 x 24. Cut the brass to the shape shown and the size to suit your requirements. Bend the upper edge to form a protection from snow, etc; drill the screw holes with a No. 6 drill and tap with a 14 x 24 tap. Drill the holes for the wires so that the wires will barely slip thru tightly.

Contributed by RAY T. ELLIOTT.

AN ARC BUZZER PRACTICE SET.

Since restrictions have been removed from amateur transmitting stations, it is still necessary to use buzzer sets to keep in practice on the code. The ideal practice set is one that will give an exact reproduction of a wireless set.



The buzzer is connected in series with a 25-watt lamp.

The apparatus needed for my practice set is a small buzzer set, consisting of a high-tone buzzer and a key mounted on the same base, such as is sold by any wireless supply house, a 25-watt lamp, a telephone condenser, and a source of 110 volt direct current. Connect as shown in the diagram. Adjust the buzzer so it gives a rather ragged, high-pitched note and screw the key down tight. Then to transmit signals, instead of pressing on the bakelite knob, touch the metal part of the key.

When you touch the key your body acts as a condenser in the phone circuit and so varies the frequency and therefore the note in the phones perceptibly. This sounds just like a station with a singing arc operating thru heavy static. With a scheme like this you get very fine practice in receiving thru static and interferences.

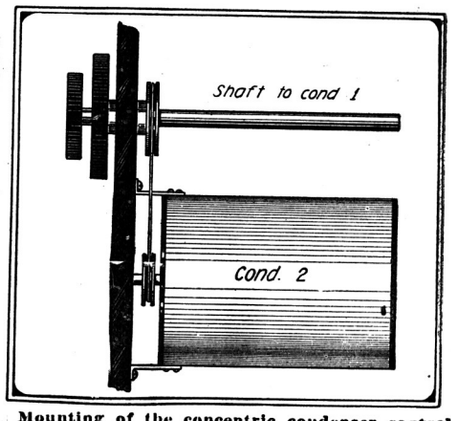
Contributed by R. E. MATHES.

CONCENTRIC KNOB CONDENSER CONTROL

With the modern undamped receiving sets requiring two or more variable condensers, one of which is usually oil-filled, the experimenter finds difficulty in placing controls on the average size panel. The following description and the accompanying diagram show a compact and efficient method of mounting two condensers on less than four square inches of front panel space.

Two concentric knobs such as are used on most types of variometers, are mounted on the front of the panel with their pointers and scale. The inner shaft may be geared by a simple arrangement, to a vertical oil-filled condenser, while the outer is attached by a pulley to a horizontal condenser mounted on the back of the panel.

Contributed by T. H. LASSAGNE.



Mounting of the concentric condenser control for two condensers.

RADIO DIGEST

PROBLEMS FOR WIRELESS OPERATORS

By W. H. Eccles, D.Sc.

More information is wanted on the measurement of change signal strength when land or mountain ranges lie between a ship station and a high powered shore station. For instance, a ship when rounding the bend of West Africa on the Cape route, gradually brings land between European stations and itself.

Another problem which needs investigation is: What distance do the directive properties of a directional aerial persist? It is the common belief among theorists that at a great distance signals should be equal in all directions. The writer's own investigations made on Atlantic trips show that the directive properties are decidedly pronounced at distances of several hundred miles.

(Abstracted, Oct. *Wireless World.*)

D. C. ROTARY GAP SET

A transmitting set which operates on direct current has been developed by L. M. Cockaday of New York City. A rotary interrupter is mounted on the same shaft as the rotor of the spark gap. This interrupter in series with the primary of the transformer, can be made to give 500 sparks per second in the secondary circuit. The stationary electrodes of the spark gap may be shifted so that a spark occurs when the primary circuit is broken by the interrupter.

(Abstracted, Oct. *"Wireless Age."*)

SYSTEM OF RADIO FOG SIGNALING

In cooperation with the Bureau of Lighthouses, experiments are being carried on by the Bureau of Standards to establish a radio fog signaling system. Such a system, when perfected, will give to the navigator a reliable signal under any conditions of fog and make him independent of the lighthouse lamp. The principal object to be sought is the sending out of a radio signal automatically from a lighthouse and the reception of this signal upon a ship by a very simple radio direction finder.

If a number of important lighthouses on the Atlantic coast are equipped with this system, the safety of navigation will be greatly advanced. In connection with these experiments, radio transmitting apparatus is being placed at three lighthouses in Chesapeake Bay and the radio receiving apparatus and direction finder installed on a lighthouse tender. Three lighthouses are used, so as to give comparative information on different types of modern transmitting equipment and to determine which is the best suited for this work. The apparatus is of special types developed by the bureau as a result of some of its researches on radio problems during the war.

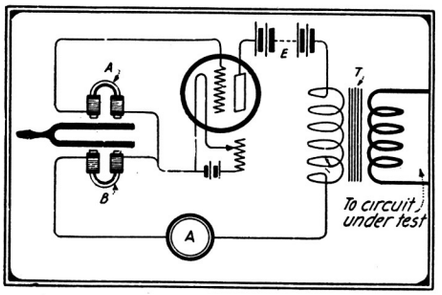
LARGEST STATION IN THE WORLD

The Marconi Wireless Co. has begun work in Buenos Aires on a station which is planned to be the largest in the world. It will be used for commercial messages direct between New York and Buenos Aires.

SUSTAINING THE VIBRATIONS OF A TUNING FORK BY A TRIODE VALVE.

W. H. Eccles and F. W. Jordan.

It is well known that oscillations of acoustic frequency are easily produced continuously by including a suitable inductance and capacitance in a triode tube in any of the retroactive connections familiar in wireless telegraphy. For this purpose rather large inductances and capacitances are required, and the set-up is therefore rather costly and bulky. Consequently it is sometimes desirable to use an alternative method. Such a method can be arrived at by replacing the inductance by mechanical inertia and the capacitance by the elasticity of matter. For example, if a tuning fork is so arranged that two electromagnets act upon its prongs, one being in the plate circuit and the other in the grid circuit of the tirode, the movement of the grid prong induces emf, in the grid coil, and this controls the plate current, which, in its turn, on traversing the plate magnet in the correct sense, sustains the motion of the fork. The arrangement is shown diagrammatically in the figure, which explains itself.—*London Electrician, June* 20, 1919.



The elasticity of matter used to provide a means of coupling between the grid and plate circuit of a triode valve.

NEWSPAPERS IN GERMANY WILL ADOPT WIRELESS

The German government is experimenting with wireless with a view to extending its use internally.

It is proposed to install stations in all the larger German cities, and to utilize the wireless as an adjunct to the existing telegraph system.

An especial advantage from use of the wireless is seen in its adaptation to newspaper purposes. A single story intended for a number of newspapers throughout the republic could be sent once from a central station and picked up by the substations in various cities. The technical work is just now being undertaken.

REMARKABLE SUCCESS OF AUSTRALIAN WIRELESS APPARATUS

The wireless operator on the S. S. "Karoola" has reported that when his ship was off the north west coast of Australia he received clear messages from an English low-power station in the North Sea which were transmitted on the ordinary short wave length of 600 meters.

This feat was achieved with the new expanse type magnifying valve receiver designed and manufactured in Sydney by the Amalgamated Wireless (Australasia) Limited. These receivers were originally designed by the company"s managing director, Mr. E. T. Fish, for demonstrating the possibility of receiving messages in Australia direct from the Marconi Station at Carnarvon in Wales.

HARMONIC OSCILLATION OF RECEIVERS

By E. W. Stone.

A cord may be caused to vibrate by impulses which are harmonics of its fundamental frequency. In a similar manner, when a receiving set is tuned to a certain wave length, it will respond to oscillations which are harmonics of its own tune. Thus, a receiving set, adjusted to a tune of 15,000 meters will respond to signals on a tune of *approximately* 5,000 meters, its third harmonic. When the receiver is oscillating harmonically in this manner it is difficult for the operator to tell whether he is receiving signals on the fundamental oscillation of his receiver or on an harmonic, so he should search the lower range carefully, in order to obtain the true wave length of the transmitting station.

The foregoing is an abstract from one of the many interesting paragraphs to be found in *"Elements of Radio Telegraphy,"* a new book by Ellery W. Stone. Up-to-date types of receivers are treated in detail; also the book is an authoritative reference on impulse transmitters.

QUANTITATIVE EXPERIMENTS WITH COIL ANTENNAE IN RADIO-TELEGRAPHY.

I. W. Austin.

The writer derives equations that show that, other things being equal, if antennas be used both for sending and receiving, the received current falls off as the wave length, while if one coil be used, it falls off as the square of the wave length and with two coils as the cube of the wave length. Test data were obtained at the Arlington station using coil antennas.—*Journal Washington Academy of Science, June,* 1919.

NEW DUTCH STATION

The Dutch Government soon will begin the erection of a radio plant powerful enough for direct communication with the Netherland East Indies, at a cost exceeding $2,000,000.

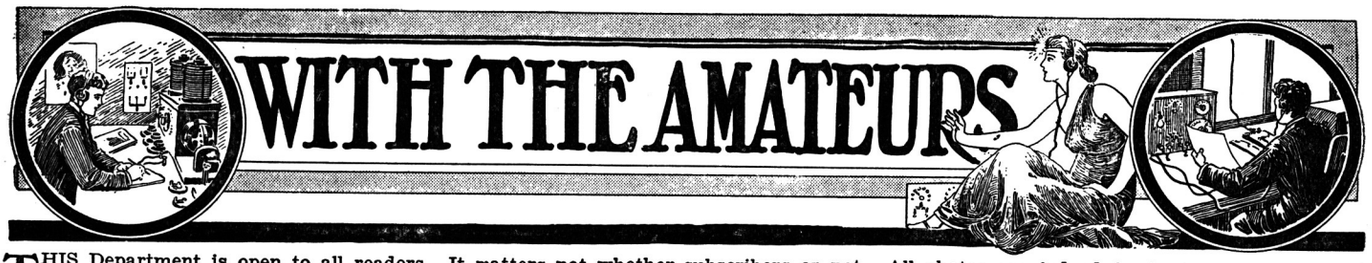
NAVY MAN GIVES ALBANY CONCERT BY RADIOPHONE

Albany radio amateurs were treated recently to the first demonstration of radiophone in Albany.

Richard D. Swanson, radio operator of the destroyer Blakely, tied up at the Albany Yacht Club pier, for an hour gave a demonstration of the transmission of music from a talking machine in his quarters by radiophone that was heard with distinct clearness by Albany amateurs. Later, in his quarters, he said that although his radiophone set was only capable of transmission within a forty-five mile radius, navy operators in New York, 143 miles away, had heard his concert.

RADIO STATION CLOSED.

Because the wholesale discharges of enlisted men have not been made up by reenlistments, the radio station at the Naval Academy, Annapolis, has been shut down indefinitely. It was a receiving and sending station and all communications to the Academy from the Navy Department at Washington were transmitted by this means.

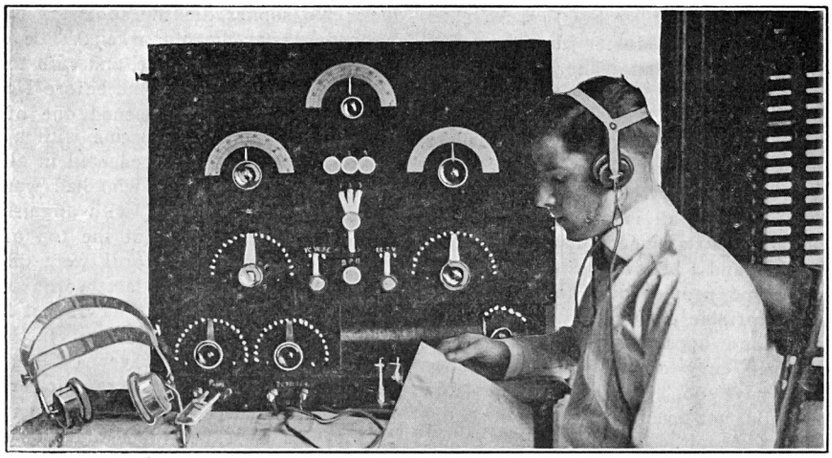


THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we make it a rule not to publish photographs of stations unaccompanied by a picture of the owner.

We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures publisht will be paid for at the rate of $2.00.

Robert Torcan's Station



The design and neatness of Robert Forcan's station wins the First Prize of $5.00.

HERE are some pictures of my set, as I think they would interest some of the readers.

I am an amateur and therefore the set is also the work of an amateur. I made it out of things found in my "lab," with the exception of two E. I. variable condensers, one consisting of 43 plates and the other of 17, and a set of W. E. phones. It is entirely home-made. The cabinet includes a Navy Type loose couple, tuner and variometer, two variable condensers, one fixed condenser, three detectors "of my own type." The small push button in center of set is for a test buzzer, one of the switches is for the control of the loose coupler, a tuner and a variometer. The other switch on the right of the set controls the three condensers, the triple bladed switch controls the three detectors, Nos. 1, 2, 3.

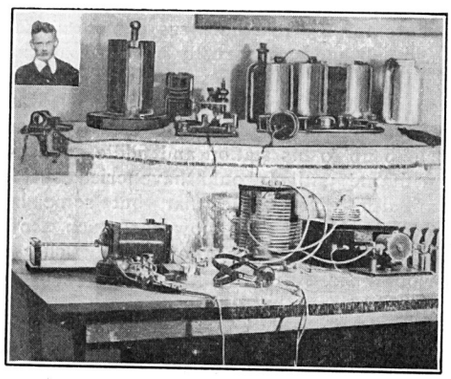
ROBERT TORCAN,
871 Cambridge St., Cambridge, Mass.

Morris Hoag's Station

PICTURE No. 1 shows my home practice set. This set consists of an omnigraph, a key, buzzer, and a single receiver and headband. On the back of this bench can be seen an unfinished Ouidin coil, which was described in the Experimenter several months ago.

Picture No. 2 is a flash exposure, using a flash sheet for illumination.

My set consists of (sending), Packard ½ K. W. transformer, 12-plate adjustable condenser, 7,500 R. P. M. rotary spark gap, and an oscillation transformer. Of course, I have a kick-back preventer, aerial switch, and key. Since taking these pictures I have mounted my aerial switch on a large marble base, which adds a lot to the appearance of the set.



Morris Hoag and his station. Note the elaborate transmitting set.

My receiving set consists of 3,000-meter loose coupler, large fixed condenser, Crystaloi detector (type AA), crystal detector, Jr. fixed condenser (across phones), and a Murdock solid type head set rated at 3,000 ohms. A small auto lighting switch is used to connect the two detectors at will into the receiving circuit.

My aerial consists of four wires, spaced two feet apart, eighty feet long, and thirty feet high at one end, by twenty feet at the other end.

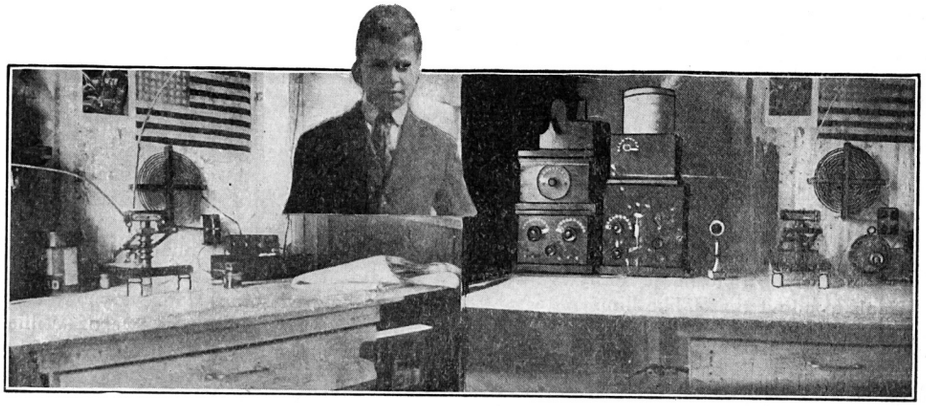
MORRIS HOAG,
Sheridan, Wyoming.

Max Pierce's Station

There are some pictures of my station sent in to show the "boys" what I have and it is hoped that others will satisfy my curiosity by sending photos and descriptions of their stations. My receiving set consists of the following: 3,000-meter receiving transformer in conjunction with a 3,500-meter primary loading coil and 3,000-meter loading coil for the secondary circuit, an electron-audio detector, crystal detector and variable condenser.

To the right of the vacuum valve cabinet is a telephone transmitter which I intend to use in connection with a radio telephone set I am now constructing and which I will be pleased to show you when completed, in these columns.

MAX PIERCE,
Corsecana, Tex.



This station is a fine one. Max Pierce has every reason to be proud of it.

Local Forecast--Stormy

By DOROTHY KANTRO

I REALLY do not know why I was chosen to tell this story except that I am directly connected with it. I claim no literary talent. I have never transmitted a message in all my life. In fact, I have done nothing but listen ever since the beginning of my existence. Some people have ungratefully named me a *Receiver*, yet I have received nothing in all my life but hard-luck stories, and once in a while some cuss words directed to me, altho in most cases I was quite innocent. Some people call me a *'Phone*, yet there is nothing phoney about me, and I try when treated right to be as truthful and frank as possible. Now that I have introduced myself, and made myself as clear as I possibly could under the extraordinary circumstances, with your permission I will proceed with the story.

It was perhaps the most eventful part of my life when Johnny Atkins first purchased me from the glass show case in which I was displayed in a small wireless shop and introduced me with due honors to the other members of his elaborate radio station. Right here I must state that the life of a receiver is not what it's cracked up to be. You would think that all radio instruments got along splendidly, but sad to relate, they don't do anything of the sort. Even among the receiving instruments there is rivalry, class hatred and envy. At first they all ignored me completely, from the aerial switch down to the galena detector. The stately loose coupler with his fashionable green shirt, dominates everyone and continuously makes funny remarks about my shape. The galena detector calls me a *tailor-made* set of cans because he points out that my long green cord is a *tail*. Only the audion has a high respect for me and treats me like a high born lady, because he confided into me that we are the only *real* sensitive instruments in the station. He says that the others are all "low brows" and that Master could dispense with all of them, and still receive messages using only the audion and myself. The loose coupler who overheard the conversation, of course, denied this vehemently, and grew so apoplectic that his green secondary got stuck on the slider rods. But the audion and I only laughed at him.

One thing greatly puzzles me. It's the audion. I admit I soon grew quite fond of him. And he is *so* wonderful. He not only receives messages but can send them as well. Radio *telephone* messages at that! And he whistles *so* devinely. And his light is so soft and inviting! But of late every time I look at him his reddish filament grows bright and lights up almost white. Perhaps he is bashful and it's his way of blushing! Anyway I am frank to admit that I like him.

To proceed.—With the entré into the Atkins family I knew I had attained the position that I had long wisht for. Not only was Johnny, or rather my Master, of a kindly disposition, but he showed such consideration for me and treated me so well that I vowed that I would serve him with all the faithfulness and good will that I could place at my command. At the Audion's suggestion, I was always careful not to hurt my Master's ears by pressing them too tight. The Audion was kind enough to tell me confidentially that Master scrapped my predecessor because she hurt his ears too much.

How proud I was with my well-polished head-dress (some people call it a headband) when I received my first wireless message! How my Master jumped up and down in his chair that made my heart almost jump to my mouth with fright. Yet what tales I could tell, and what stories I could relate that came to my sensitive diaframs in due time. But this is not the purport of my story. And, as a moral I wish to say that all is not gold that glitters. This last statement I had heard from my Master and I believe it fits my case exactly. Some people think that I have a very comfortable existence. In fact, some of my fellow apparatus of late often express their envy of my position. They think I have no grounds for complaint, and should not even think of going out on a strike, altho confidentially—and I trust it will not go any further—I had once or twice gone on a strike and refused to receive, much to the chagrin of my kind Master. I now confess that I am somewhat ashamed for this action. The cause for my rebellion was not purely selfish. I had never really revolted against my Master, but I do say that oftimes my patience was very severely tried. My Master's numerous friends would many a time climb up to his station and fiddle and fuss with me until I could have cried out in anguish. Not alone that, but some lay friend of his, who knows as much about radio as the moon knows about cheese, would persist in trying me on his bonehead until my hard rubber caps hurt. But I got even with him. I pressed his ears with all my might, so that he took me off his head in two minutes. With other fellows this method was without result. So I simply pulled my diaframs onto my pole pieces and quietly "went dead"! These troubles while of more or less seriousness to me was not my bugaboo. And here is where the story begins:

Johnny Atkins had a younger brother Willie, and take it from one who knows, whatever he "willed" he put into effect. It was no wonder that Nature had placed upon his head as a danger-signal a crop of red hair. She, I mean Dame Nature, knew what she was about. Not only were cats and dogs (except one dog who had a streak of red and who recognized in Willie a kindred spirit) and everybody else around the Atkins house in awe of Willie and his devilish pranks, but I admit weakly that Willie was my arch Enemy, and I feared no one more in all my life.

How often when my Master is engaged with me do I see the door slowly open and the sharp, mischievous eyes of Willie with mouth agape, watch the proceedings with devilish interest. I immediately knew that this interest was not in my favor, and that I would have now no further rest or peace.

Alas my pessimistic premonition was only too true. Willie had bided his time. My Master was called away, so I heard, and Willie had sneaked in the room before Master had closed the door behind him. No sooner did the footsteps of my beloved Master die out, when Willie crept from underneath the table, and with screwdriver in hand he seized me before I could make an outcry. He opened one of my caps and began to attack me with a zeal and ferociousness unprecedented in all my existence. The Audion, who had watched it all, had gone "white" with anguish. I could hear him whistle at the top of his beautiful voice till my cords were disconnected by Willie. His last words were: "Courage, I love . . ." I at last knew that my fate was sealed. But just as I was making my last prayer (Willie had already begun to dig the screw driver way into my abdomen (or pole pieces, as they call it) the door flew open and in rushed my Master with clenched fists and in great excitement. I fell to the floor with a bang and with thankfulness in my heart. But as for Willie, he made one dash to get away, but was caught in my Master's strong arms. The rest is too sad to relate. I leave it to the imagination of my readers. This was the first time that Willie and I had anything in common. He, too, became a "receiver"—but he did not "receive" *weak* signals, either, from his brother!

To explain the return of my Master: That afternoon he called in for a weather report and he was told that the Forecast was "Stormy." As the clouds were rather threatening Mrs. Atkins had dissuaded Johnny from going on his fishing trip, and he had rushed into his laboratory to signal his friends that he was not going, when he discovered Willie in the act of dismembering me, and saved me from a horrible death.

Now you see while the Transmitter might have told you this story to better advantage, I, as the victim, had been chosen to relate this tale. I trust there will be no serious consequences.

I thank you.

P. S. The Audion has just asked me to marry him! I accepted under the condition that we wait till my trousseau arrived.

A girl can't very well get married when her only set of green cords were chewed up by an idiotic, long-eared pup.

P. S. 2. We will get married next week. Master just sent an order for a new set of *silk* cords to a N. Y. mail order house. Won't the Audion "light up" when he sees me all dolled up!!

The Third Pill

By J. K. HENNEY

WE lay at the foot of Madison Avenue, sweltering in the hot July sun. The last few truck loads of freight were being rushed aboard while bellboys and stewards were trying their best to break off the remaining au revoir parties scattered over the dock. The steamer was a side-wheeler, broad, close to the water, and insufferably airless. The heat of the opprest city rushed down the street in waves, gathered up several hundred degrees from the engines below and finally floated up to my position on the after deck. The air was absolutely still, nothing seemed to move except the steam rising in a desultory fashion from the stack and the hastening truckers on the dock. The noise of the squeaky wheels below floated up to my seat in muffled tones, sounding as tho the heat had stifled the raspy racket Across the river the *Fayette Brown* was being coaled, her last two hatches nearly filled with black lumps of anthracite. Each time a car was emptied of its contents, a cloud of dust floated across on the empty air, and dropped on the decks of the steamer. The dull rattle of the coal as it shot down into the hold of the freighter only accentuated the booming and roaring in my head.

Early in the afternoon I had noticed a slight headache which increased toward sailing time. At times I was tempted to ask the captain to be relieved from duty, but it at once came to my mind that such a procedure would not help matters at all. The tiny stateroom was stuffy, and the radio cabin could not be much worse than the exhausted atmosphere outside. Only the lake seemed inviting and it was two hours away. The half hour before time for the plank seemed to go with utmost motionlessness, and with each moment my pain seemed to grow more acute.

My hand clutched a small box of pills the steward had given me in the afternoon. I always had dreaded medicine, especially the variety put up in small pellets. It was foolish not to take one of them, I thought, but to save my life I could not do it. From moment to moment I thought of the lake with its breeze, and decided to wait until later to take one of the pills.

When the blast of the whistle finally announced that we were clear of the dock, I breathed a sigh of relief. The earsplitting toot tore through my tortured nerves like a dull knife, and as the Cherry Street bridge went up, I made my way slowly to the radio room through an almost impassable crowd of heat-fleeing passengers.

"The generator had come to life, its pig nose was gazing at me with the utmost hatred in its expression."

Once in the radio room, I sank into my chair, every nerve taut, every blood vessel throbbing with tired, sick and aching blood. Off the yacht club I sent our position report to Detroit, received the answer, and then pulled the round box from my pocket. I looked at the contents—four small, round, white pills—with mingled mistrust and relief. I thought of what the steward uttered as he counted the tablets into the box.

"One of them will stop a man-size headache," he had said, "two will stop an elephant's headache, and the third will kill a man."

He was joking, of course, but somehow I remembered his words. Out in the bay I sent several messages for passengers, and then decided to try one pill. My pain was not leaving me in the least, despite the fact that we were out in the clean air of the lake. I was staring a sleepless night in Detroit in the face, and I mentally prayed that one pill would be enough to stop the pain. The first dose was soon swallowed, and I sat stupidly in my chair, the receivers strapped over my ears.

ONE CENT A WORD FOR YOU.

If you have a good true story to tell us about yourself or your station or any unusual radio occurrence or matter connected with radio, we want that story. We will pay one cent a word upon publication for all accepted stories. We desire you to feel that this new magazine is your magazine, and we will do all in our power to make it so. We want to make it as human as it is possible. Will you help?

Behind and below me the throbbing engines tried to keep time with my pulsing blood. In half an hour we passed Maumee Light and I took the second pill. Still the ache continued, and I thought of the fever. We had been unfortunate on the way down from Mackinac in breaking our water purifier, and already two of the crew had been taken ashore to the marine hospitals. After we had passed the light far astern, and were out in Lake Erie proper, I took the last pill.

My chair was stilted back against the switchboard, my feet on the pig-nosed generator below the operating table, and my head on the back of the chair. Suddenly I looked at the pill box. There were still three pills in it. The apparent lack of harmony in my actions and thoughts rather struck me at the time, but in my stupor I thought I had not taken the pills at all. Hence I began again the process of taking a dose every half hour. When it came time to take the third pill, I thought of the steward's words:

"And the third will kill a man."

I decided to wait. If my head still pained when we reached the river I should not care if the third pill did finish me. Our vessel laid up at Detroit during the night, and the prospects of sleep in that stuffy river port were not particularly encouraging. At my back the pounding walking-beam could be heard in its unceasing pound, up and down, up and down. The shadow of the piston rod fell through the skylight between the radio room and the engine room, making a line across my table at each revolution.

The small cubbyhole situated in the middle of the ship wherein the radio apparatus was installed had been a linen closet before the days of wireless. From my seat I could count the revolutions of the paddle wheels outside, and as is customary with side-wheelers, each turn of the wheels meant a vibration that went through the ship. In this small room the noises seemed to concentrate, and my tortured brain repeated over and over some melody to the time of the pounding engines below. Vainly I tried to think of the words of the song, trying at the same time to make the meter rhyme with my heart beats and with the pumping piston rod. And each time it seemed as tho my head would burst with pain. At last I reached for the third pill, determined to end it all with the last dose, when suddenly it came to me what the tune was I was trying to sing. It was the words of the steward timed to the revolutions of the paddle:

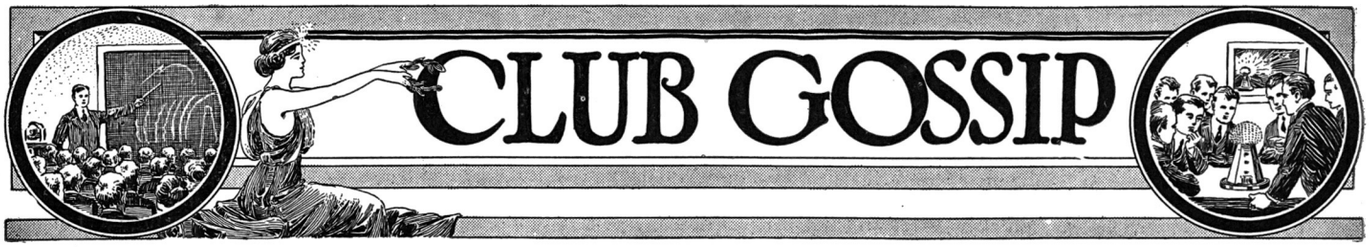
"AND THE THIRD PILL WILL KILL A MAN."

Panic stricken, I rose and threw the box from the room, locking the door behind it. With a cry of pain I staggered back to my chair and covered my face with my hands. This pain was really unendurable, but better bear that than be killed by the abominable pills, thought I. When I again opened my eyes, I noticed that the box was in its former place beside the transmitting key, and that there were three round, white pellets in it. Uncomprehending what was wrong, I merely sat there and gazed. Then things began to happen with startling rapidity. First the pills began to change in color. The first one changed into a deep malevolent red. The others followed suit, while the first one—how shall I ever forget the scene—the first pill suddenly took on legs and began moving around with a sickening stagger. I brought my hand up in horror as I recognized the form of the four-legged pill. It was that of a lizard with the steward's face for a head. My hand struck the light and in an instant all was darkness.

When at length I had found the light and the room was once more dimly lighted, the lizard was gone. I brought myself up sharply.

(*Continued on page* 255.)

"It pounded and pounded each time striking me down, down, down, until I felt myself going thru the floor."

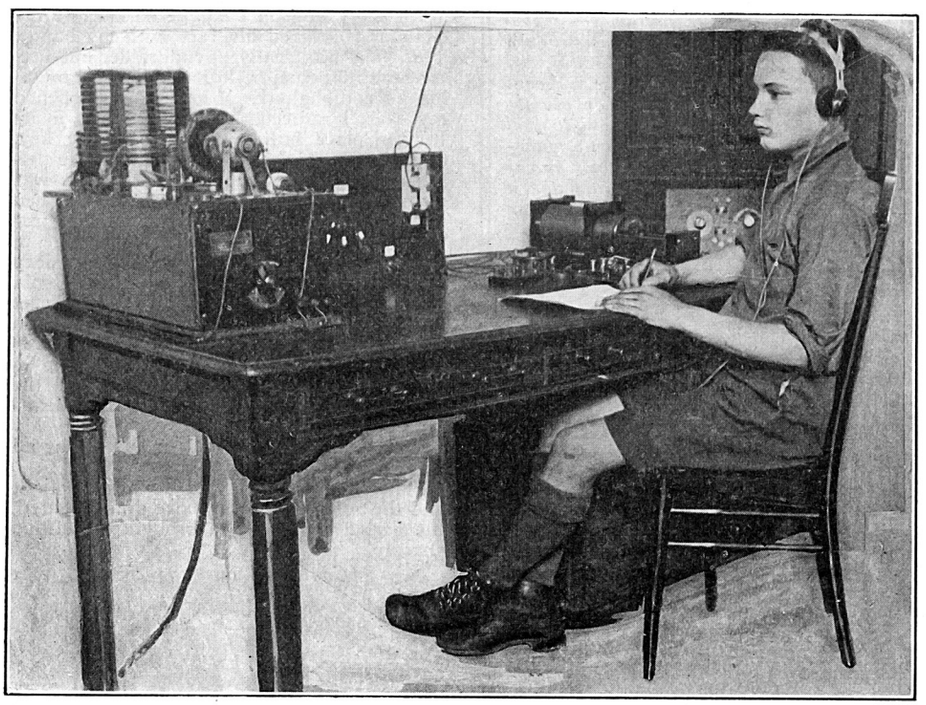


SCOUT JACK WILKINS IS A YOUNG MARCONI.

By Boy Scout Editor the *Sunday American*, Atlanta, Ga.

First-class Scout Jack Wilkins, of Troop 15, has completed his new radio station and receives radiograms every night from Arlington, Va.; Key West, Fla., and other big government stations, as well as numerous ships along the Atlantic seaboard.

Scout Wilkins uses a four-wire antenna stretched above his home at 715 North Boulevard to pick up the mysterious wireless waves from the ether. This set is arranged in an orderly manner and so that the instruments are most efficient. A neater amateur station could hardly be found. The Government allows amateurs to receive, but has requested them not to send messages until further orders, so Jack can only use the receiving end of his station now, while he waits impatiently for permission to throw on the rotary gap and send 15,000 volts flashing into the air bearing his messages.



First class Scout Jack Wilkins waiting for N. A. A. Press. Note the neatness of his station.

The sending set consists of a one-half kilowatt Packard transformer,' large sending condenser, oscillation transformer and three-speed rotary spark gap, all mounted neatly on a box twelve by twelve by twenty-four inches. Scout Wilkins is confident this set will send 500 miles and he is anxious to try her out as soon as he can. The receiving set which he now uses consists of a Duck loose coupler, fixed and variable condenser, galena crystal detectors, and Brandes head phones.

This young Marconi has under construction at present an audion panel receiving set with which he will be able to receive thousands of miles. He is also building a portable field wireless set, which Troop 15 will use while on hikes to keep in touch with their troop headquarters in Atlanta.

Scout Welsh Geeslin, also of Troop 15, operated a wireless station before they were ordered closed for the war and is a member of the Atlanta Radio Club.

"Wireless" is one of the Scout merit badge subjects, and Scouts have always shown a great interest in radio telegraphy. When we declared war the older Scouts volunteered their services for radio and signal corps work where they would be worth most to the military forces. In the event of another war, upon the shoulders of just such amateurs as these Scout operators will fall the job of keeping up communication lines for our army and navy.

A. S. M. Boyd Taylor.

LUVCONE RADIO CLUB

The Luvcone Radio Club reorganized September 17th. At this meeting the constitution was changed slightly and six new members admitted into the Club.

Each member purchased an authentic work on wireless telegraphy and the Club is to hold classes with this book as their text-book. Later, a buzzer practice system is to be obtained and code practice worked upon.

The reorganization of the Club shows each member to be enthusiastic and willing to work. With this condition confronting them, many good times as well as beneficial results are to be had.

Ideas will be very gladly welcomed from any radio club or any individual interested in the organization. The Club desires very much to obtain any correspondence from such a source. Address all communications to

Norvell A. Canfield,
Secretary.

AMATEUR RADIO OPERATORS TO REORGANIZE.

Reorganization of the Houston Amateur Radio Club, an organization composed of amateur wireless telegraph operators, was taken up at a meeting on the roof of the Carter Building. The purpose of the organization is to study wireless, send and receive messages to all parts of the world, and to relay messages between distant points.

When the war broke out Houston had several amateur stations. They were dismantled pursuant to orders from the Navy Department. The amateur stations are allowed to receive messages now, and will soon have authority to send them, as they did during pre-war days. The reason given by the Navy Department for ordering the wireless stations dismantled was that they interfered with government messages being transmitted from one part of the country to the other. At the same time the government drew most of its wireless operators from the amateur stations and put them into active service on sea-going vessels.

Any person interested in wireless telegraphy may become a member of the new organization, according to James L. Autrey, Jr., and C. W. Vick, who have called the reorganization meeting. Mr. Autrey said before the government ordered his station dismantled in 1917, he received wireless messages from 22 states, some of the messages coming from New York and Massachusetts, and others from Chicago and the Great Lakes region. Numerous messages from steamers on the high seas were picked up by the amateur stations in Houston.

CENTRAL ILLINOIS RADIO CLUB ACTIVE.

Jacksonville, Florida. — Wireless telegraph enthusiasts of this city are planning to revive interest in the Central Illinois Radio Club, which became an inactive organization when the government caused all amateur stations to be dismantled. A meeting was held at the Y. M. C. A., at which time committees were appointed to start things moving.

Edward Wackerle, Philip Dooling and J. Clarence Walsh were named as a committee to confer with directors of the Central Illinois Radio Club, relative to a transfer of the latter's station to the new club. W. H. DeShara and Anthony Branom were appointed to draw up a constitution and by-laws for the new body.

UNIVERSITY RADIO RESUMES OPERATIONS

The University of Pittsburgh radio station, one of the most powerful of university wireless plants, is again in operation, after a long shutdown in compliance with Government orders.

THE TESLA-MARCONI CLUB

HIGH schools can do a great work in creating an interest among amateurs in the locality where they are located. The Physics Laboratory can be equipped with a station for receiving and sending, placed in charge of a group of boys interested in radio. The work of one high school is here described.

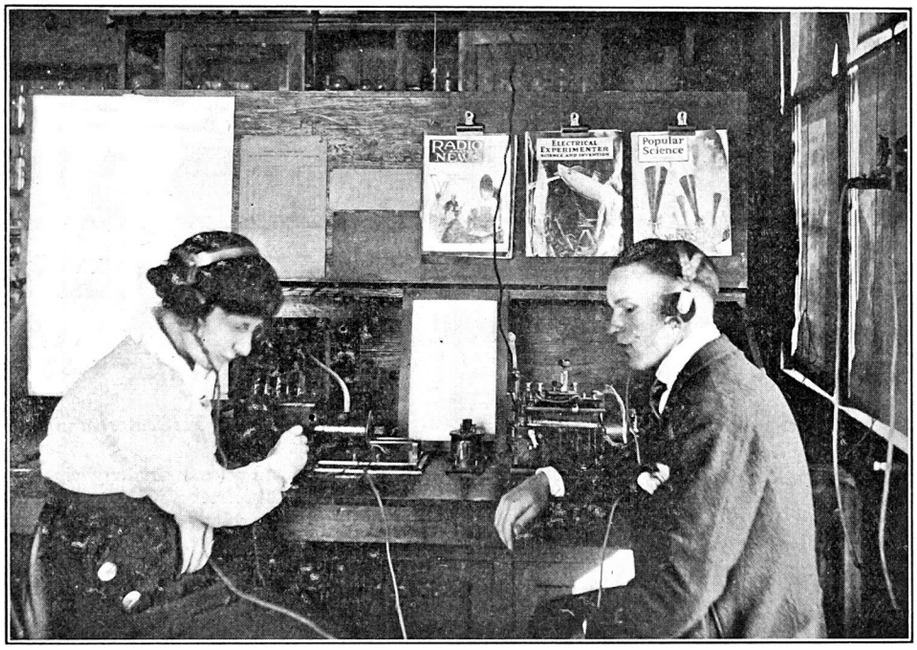
The Tesla Marconi Club was organized in 1913 by Mr. M. J. W. Phillips, head of the Science Department and instructor of physics, himself an ardent radio amateur. The membership was limited to twelve boys selected from the high school, boys interested in radio.

We have a complete three-quarter kilowatt sending station and also a receiving station. Most all of the apparatus is of our own construction, much of it designed by club members and constructed in our Manual Arts shops.

The Club has just reorganized this season, with several new members, all going into wireless with heart and soul. Mr. Phillips has planned to have the Club give about six benefit motion picture entertainments in the High School Auditorium during the year. We expect to use the proceeds to secure all new receiving apparatus, an audion set with a two or three-stage amplifier and a loud-speaking phone, so that all the members of the Club may hear the signals thruout the laboratory.

We are all working now to "brush up" on the code and get the new fellows to be proficient in receiving. In the past we received the "time" signals from Arlington and Great Lakes, Illinois. Also, the weather forecast daily. The "time" committee set the master clock each day, so our classes are run on standard time received by wireless. Another group had several copies of the weather forecast typewritten and posted about the High School. This practical work showed the rest of the students that our Club work brought results. (Enclosed is a copy of the Weather Forecast Blank printed in our own print shop.

The Club has elected Miss Ruth Neprud, one of the Science Instructors of the school, as an Honorary Member. Miss Neprud has become very much interested in radio and is a "regular fan." She attends the meetings regular and gets "right in" with the boys. In the picture of the station she is shown listening in to NAA. All the members are planning to have stations at their homes. Six of us already have receiving stations.



Two members of the Tesla-Marconi Club listening in at the High School station.

Daily Weather Report
received by
TESLA MARCONI CLUB
of
West Allis High School
as sent out by
United States Government Wireless Stations
at
Arlington, Va. and Lake Bluff, Ill.

Weather Forecast for _____
for
1 Great Lakes Region _____
for
2 Milwaukee and vicinity _____
Pressure _____ Temperature _____ Wind _____
Received by
_____ Operator Time _____
Remarks

Weather report blank printed in the High School print shop.

The officers of the Club are:
Theo. Gevaart, President.
Russell De Bruine, Vice-President.
Wm. Noble, Secretary.
Arthur Bostrum, Treasurer.
Vivian Hughes, Radio Engineer.
Wm. Runge, Chief Operator.

The dues are one dollar per year.

The Official Magazine is the RADIO AMATEUR NEWS, for which a subscription has been ordered, and it is now in the School Library.

Members of the Tesla-Marconi Club. There were thirteen, hence the fair one for luck.

TO AID RADIO AMATEURS

Secretary Daniels Says Transmission Restrictions Will be Removed.

The American Association of Engineers, through Kay B. Knudsen, the secretary, has made public a letter received from Secretary of the Navy Daniels giving his views on amateur wireless operators. He told the engineers that restrictions relative to amateurs receiving messages had been removed and that restrictions against amateur transmission would be removed just as soon as the President declares a state of peace exists.

"The Navy Department is not contemplating any legislation that will permanently restrict amateurs," the Secretary wrote. "On the other hand, we are contemplating legislation which we hope will be of much benefit to them and to the country at large. We regret that there is a misunderstanding on the part of the amateurs as to the attitude of the Navy Department and that they do not realize that the Navy Department appreciates their service to the country during the past war.

"Not only do we believe that the services of the amateurs during the war were a great aid to the country in time of need, but we also believe that every step should be taken to encourage amateurs in the future. In addition, the Navy Department realizes that from the ranks of amateurs there have been and will be delevoped scientists of value to the country.

Junior Radio Course

By W. A. HEPPNER, Associate Editor

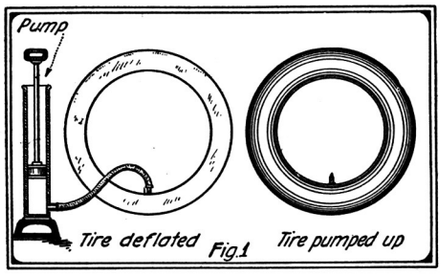
Lesson Three

THE CONDENSER AND ITS USE

IN concluding Lesson Two it was stated that a transformer and spark gap alone, formed a crude combination for transmitting wireless waves. These waves would not be very powerful and therefore the desired distance could not be covered. The device necessary to make the combination transmit its greatest amount of energy into the air is called the condenser. This is a device for storing up energy in the form of an electrostatic field. A simple condenser consists of three parts; two plates of metal sheeting separated by a dielectric (some insulating material such as glass, hard rubber or mica).

Let us now take up the condenser in detail by studying the analogy in Fig. 1. We have often observed a man pumping up an automobile tire. What happens? The air is forced into the tire and exerts a pressure uniformly over its inside surface. This pressure causes the rubber tire to expand, or in other words, the tire is stretched and due to its flexibility, it exerts an opposite pressure upon the air.

Similarly in a condenser, Fig. 2, if we apply an electrical pressure to the two metal plates we literally force the dielectric to expand inwardly. The important point to remember, then, is that the property the condenser has of holding electricity *is due to the electrical straining of this dielectric.*

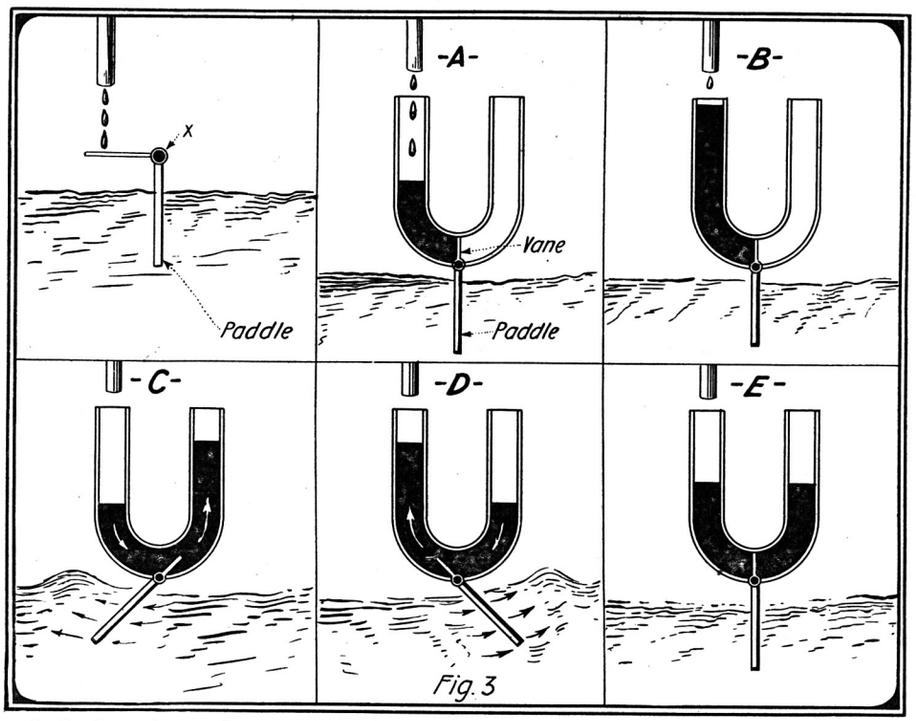


The dielectric of a condenser may be compared with a rubber tire.

Returning again to our analogy we have another point to consider. The amount of air that tire will hold depends upon the flexibility of the rubber. In other words, we may call this flexibility of the rubber, the *capacity* of the tire.

In a like manner the amount of electricity which a condenser will hold depends upon the "flexibility" of the dielectric between the plates. To express it electrically then, we might say that the capacity of a condenser depends upon the amount of strain upon the dielectric. Of course we cannot see this straining but we may with the aid of electrical instruments, ascertain that a current is flowing into the condenser when an electric pressure is applied.

We also observe that, as more air is forced into the tire the opposite pressure of the rubber due to its flexibility increases until it is equal to the applied air pressure. We now say that the tire is inflated *or charged.* If we obtain a large pump and attempt to force more air into the tire it may burst. Likewise if we apply an electrical force to a condenser, due to the straining of the dielectric of this condenser a certain quantity of electricity will be forced into it. This will continue until the condenser exerts an electrical pressure equal and opposite to the applied force. *The condenser is now charged* and if we attempted to increase the appplied electrical force we would be in danger of puncturing the dielectric.

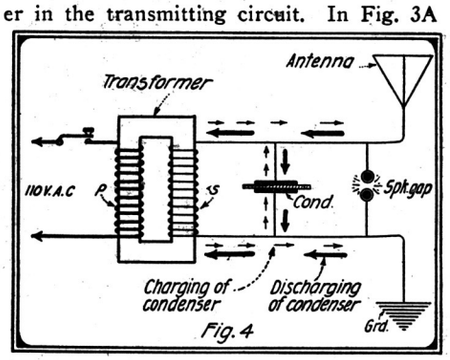


A simple water analogy of the effect which a condenser produces in the transmitter circuit.

Suppose that we attach another valve to the tire, set so that when the tire is inflated or charged to its maximum, the air will suddenly be released and the tire will become deflated. In other words, we want to make use of the air power stored up in the tire.

In the same manner a condenser would be of little use in the transmitting circuit if we didn't have the spark-gap. The spark-gap *acts in the same manner as the extra valve in the tire.* When the condenser has become charged the resistance of the air between the electrodes of the gap is broken down, the condenser then discharges itself across the gap in the form of a powerful spark.

Now we come to the use of the condenser in the transmitting circuit. In Fig. 3A we see that if water from a thin tube be allowed to drop on the horizontal arm of a paddle pivoted at X, the waves created



Circuit showing the charge and discharge of a condenser.

by the movement of the paddle in the pond are of a very small and feeble nature. As stated in our last lesson, these minute waves do not carry very far. If this water were allowed to drip into a tank or container we would be able to release the stored up water at intervals, so that a powerful wave would be created by the paddle in the pond.

Similarly, *we desire to use the condenser to store up energy* so that more powerful wireless waves can be sent out when it discharges across the spark gap.

It can be readily understood that when alternating current is used to charge the condenser, the latter is *charged first in one direction and then in the other.* This is also true of the condenser when it is discharging.

The water analogy of the charge and discharge of a variable condenser is shown in Fig. 3. If a quantity of water is released suddenly into one side of a U-tube, the momentum of the water tends to send it upward in the other side of the tube. Due to the same force it returns to the original side. This to and fro motion continues *until the energy* has been entirely expended and the water comes to rest.

At the bend of the tube let us now place a paddle pivoted as shown in Fig. 3A. The upper end of the paddle extends into the tube, while the lower end is allowed to swing in a body of water. Now water is poured into one side of the tube until it is full, as shown in Fig. 3.

The weight of the water now forces the upper vane of the paddle to the right and the lower end creates a sudden and powerful wave in the pond, as shown in Fig. 3C. The water, in returning to its original position again causes the paddle to send out a wave, Fig. 3D. The waves continue to be sent out until the to annd fro, or *oscillating,* motion of the water in the tube ceases and comes to rest, as in Fig. 3E.

If we now return to our condenser, we will readily see that the principle is much the same. Referring to Fig. 4, the high voltage of the condenser forces a current into the condenser, thus charging it to its maximum capacity.

Just as the paddle held back the water in the U-tube until it was full, the spark gap likewise keeps the charge in the condenser until it has reached its maximum. The condenser having been *charged to its full capacity,* now *discharges across the gap* and thus causes a powerful wireless wave to be sent out from the aerial, just as the water in the tube forced the paddle to create a powerful wave in the pond. Also, as water in the tube surged back and forth, the condenser is charged first in one direction and then in the other and discharges in the same manner.

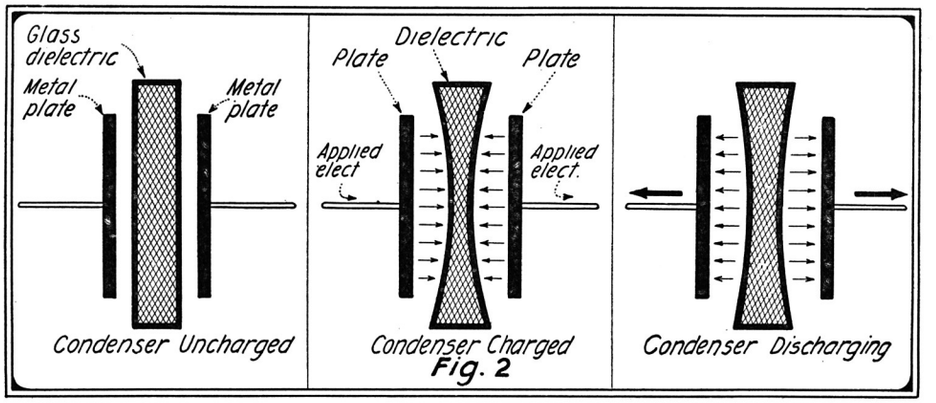


Fig. 2

Here we see what happens when a condenser is charging and discharging.

While the spark transmitter shown in Fig. 4 produces excellent results, it is still very crude. The wave sent out from its antenna is of a varied nature. It is not *sharp.* That is to say, the receiving station will be able to pick it up *over a wide range of wave lengths.* To explain this by an analogy. Try by means of a wide open, ragged nozzle of a garden hose to force a stream of water thru a knot hole in the fence, standing a few feet away from the fence. Result, the water will splash all over the fence and but little will go thru the hole. Now take a well-made nozzle which gives a thin, fine stream of water. You won't have much trouble not to "shoot" the entire water stream thru the knot hole. The latter method compares to good *tuning.*

In our next lesson we will show why a *tuning coil* is necessary in order to send out a wave of desired length.

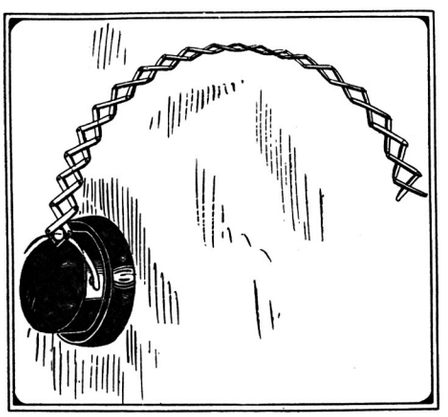
THE JUNIOR CONSTRUCTOR

A COLLAPSIBLE HEAD SET

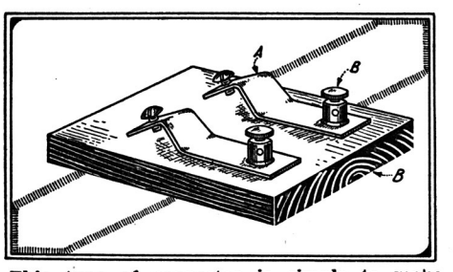
In making a portable outfit at one time I was forced to conserve as much as possible in room. The thing that took up most room was the headset. Looking about for a solution to the problem that confronted me I stumbled upon my mother's old collapsible pocket book and an idea.

Fastening the frame with a screw,—result—

Contributed by
ROBERT D. BARNARD.



Here is that hand-band you have been longing for.



This type of connector is simple to make and is reliable.

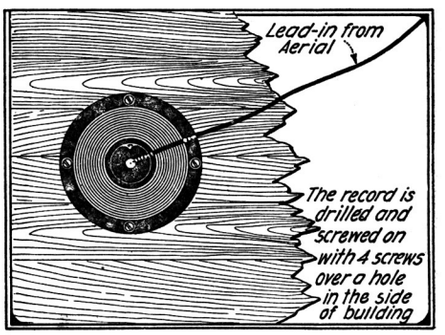
RECEIVER CONNECTOR BLOCK

The drawing is almost self-explanatory. "A" is a strip of brass, bent in the approximate shape shown, and drilled to hold the set screw and to catch the mounting screw, the latter screw coming up from the bottom of the base and passing through the brass strip and the binding post. "B" is an ordinary binding post. "C" may be made of hard wood, fibre or hard rubber. The whole device is simple and effective, and provides a ready means for making connection to the receiver cord tips. No dimensions are given, for the simple reason that they are unnecessary, and the constructor is allowed a wide scope in both the size and kind of material used.

Contributed by ROY NELSON.

LEAD-IN INSULATOR FROM PHONOGRAPH RECORD

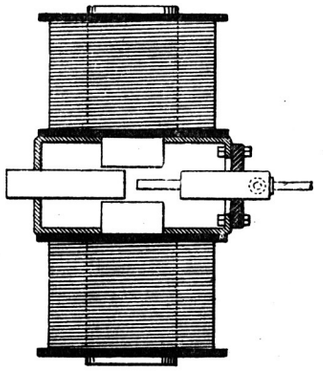
A very efficient as well as clever scheme for furnishing a lead in insulator is shown in the sketch below. An ordinary phonograph plate type record is first procured. Four holes are bored in same, so as to fasten it to the wall. A hole is drilled through the center and an eight-thirty-second screw with sufficient nuts to clamp it to the record is also furnished. The lead in wires are connected to that portion of the eight-thirty-second screw which protrudes outside the building. Wires to the instruments are then connected to that portion inside.—(*Contributed by Don C. and Bill Brockway.*)



Another use for old phonograph records.

Electrical Oscillation Arc Generator.
(No. 1,298,490, issued to Leonard F. Fuller.)

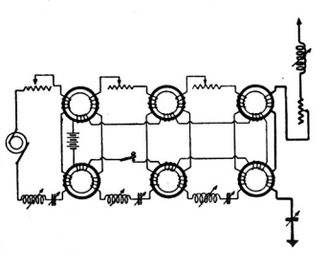
An object of the invention is to provide an arc generator which has a large power output in proportion to its size. When the generator is connected in a radio transmission system,



the cathode is connected to earth and the anode to the antenna and they are also connected to the opposite sides of a suitable source of direct current, which produces the arc. A very small potential difference exists between the poles and the cathode, hence there is no tendency for the current to jump from the cathode to the poles and the poles may be placed as close to the cathode as desired. The potential difference between the anode and the poles, however, is relatively high and the poles must be spaced away from the anode a greater distance than the spacing of the cathode and the poles. The anode and cathode must be spaced apart a suitable distance to produce the desired arc. If the anode and cathode were of the same thickness, this would require that the poles be spaced apart a considerable distance, and in order to maintain the desired flux density, a large amount of copper and iron must be used in the magnetic circuit. In order to overcome this difficulty and to permit a much closer arrangement of the poles, the anode 3 is provided with a tip 7 of much less width than the cathode, so that the distance between the anode and the poles is greater than the distance between the cathode and the poles.

Transmitting Apparatus for Wireless Telegraphy and Telephony.
(No. 1,308,514, issued to Georg von Arco and Alexander Meissner.)

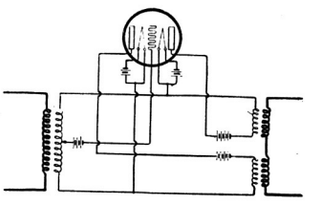
High frequency oscillations which have been heretofore used in transmitting stations for wireless telegraphy and telephony, have been produced heretofore chiefly by means of sparks or electric arcs.



Here is shown an arrangement for multiplying the frequency of alternating currents comprising an alternating current generator, a plurality of sets of frequency changers for multiplying the generator frequency, each set comprising mono-inductive alternating current resistances, having closed iron cores and primary and secondary alternating current windings and an auxiliary magnetizing winding mounted thereon, and a working circuit receiving the energy from said frequency changers; the generator and frequency changers and working circuit being connected by oscillation circuits and means for rendering these circuits approximately aperiodic to render transmission of energy from the generator to the working circuit as independent as possible from the variations in speed of the generator.

Electric Wave Repeating Apparatus.
(No. 1,307,511, issued to Alexander McLean Nicolson.)

This invention relates to electric wave repeating apparatus, and particularly to the use of vacuum discharge repeaters, as exemplified by



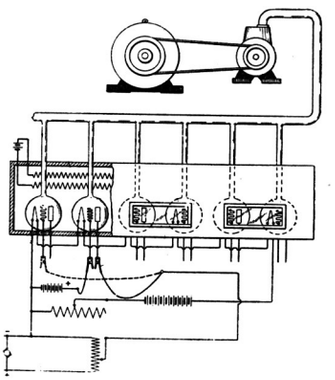
the so-called audion, for repeating and amplifying in an output circuit waves of electric energy received in an input circuit. An object is to improve the quality of transmission by producing, in the output circuit, electric waves free from distortion with respect to the input waves.

It is especially useful in telephone and telegraph systems for repeating and amplifying alternating current waves of small magnitude.

This electric wave repeating apparatus of the audion type comprises a divided input and divided output circuit; means for producing two space current paths, these paths being oppositely included in the output circuit, and a variable potential cold control electrode common to said paths.

Manufacture of Vacuum Tubes.
(No. 1,297,309, issued to Harold Donald.)

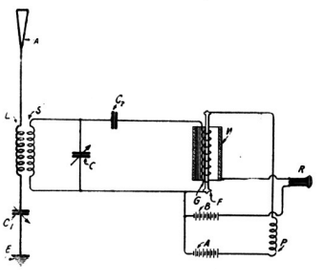
This invention relates to a method of exhausting air and



other gases and vapors from the glass bulbs or containers, which inclose the electrode elements of thermionic repeaters, such as audions, and similar devices in which extremely high vacua are desired. Its objects are an effectively complete elimination of the gases occluded by the walls of the containing vessel, and by the electrode elements and other metallic urfaces inclosed therein, a removal of such gases or any other gases from the containing vessel, and a resulting product characterized by stability and uniformity of operation. To these ends this invention provides for the attachment of the vessel to be exhausted to any suitable vacuum pump and for the application of heat to the exterior of the vessel during the process of evacuation. It further provides for the heating of one or more of the inclosed electrodes by the passage of an electric current there through, and for the production of an electron discharge which may be made to bombard and heat another electrode through the application of a suitable potential difference between the electrode and the source of discharge.

An Open-Air Audion.
(No. 1,299,356, issued to Dr. Lee DeForest.)

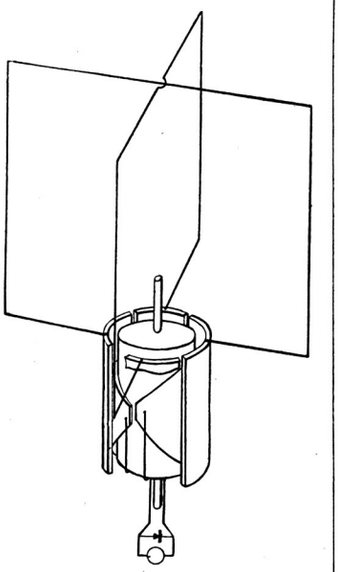
Heretofore, it has been necessary to inclose the electrodes of the audion in an evaculated vessel for various reasons, one of them being that the filament electrode, being more commonly a carbon filament, would oxidize in the open air, and would immediately burn up. Dr. DeForest has found that by employing a Nernst filament, this objection is overcome, and consequently an open air audion, as distinguished from the audion the electrodes of which are sealed in an evacuated vessel, can be employed. It will be noted the cold electrode G which in this



instance is the grid electrode, surrounds the Nernst glower, and the plate or wing electrode W is in the form of a plate which surrounds both the grid and filament electrodes. The signal receiving device R is connected between the ring and filament electrodes in series with the current source B in the usual manner.

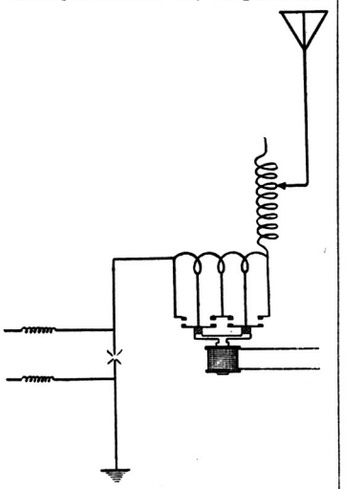
Directive Wireless Telegraphy.
(No. 1,297,313, is issued to E. Bellini.)

This invention has for its object to provide wireless telegraph and telephone apparatus which allows, in regard to transmission, of controlling the direction of maximum projection of electromagnetic waves, without turning the antennae, and in regard to reception of making adjustment for reception from selected directions and ascertaining the direction of the transmitting station also without moving the antennae. The apparatus essentially comprises pairs of fixed conductive plates arranged around an axis, diametrically opposite each otrer, the number of pairs being equal to the number of aerials for directed waves, and the two opposed plates of each pair being connected to one of the aerials. Opposite the fixed conductive plates are arranged rotable conductive plates directly or indirectly connected to high frequency apparatus such as a sparking device, an arc, an alternator, or a detector. These rotatable plates are mechanically connected to each other, and can be rotated about the axis of the fixed system, so that they can be placed opposite the two plates of any of the fixed pairs, or in any intermediate position. The fixed conductive plates and the movable conductive plates are arranged in co-axial cylinders, a short distance apart.



Arc Transmitter Key Relay.
(No. 1,300,156, issued to Leonard F. Fuller.)

The apparatus of this invention is particularly useful in a transmission system employing continuous oscillations, and particularly a system employing an arc as the source of continuous oscillations. In such systems, signals are produced by making a small change in the length of the radiated wave and this is usually accomplished by varying the inductance of the oscillatory circuit, preferably by short-circuiting a portion of the inductance. In high power transmitting stations, the currents which must be handled by the short circuiting apparatus are large and difficulty has heretofore been experienced in opening and closing the circuit. In accordance with this invention, a multiple contact key is provided



and so arranged that each contact carries only a portion of the current, regardless of whether all of the contacts are closed or opened at the same time or not.

THIS Department is conducted for the benefit of our Radio Experimenter. We shall be glad to answer here questions for the benefit of all, but we can only publish such matter of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.

2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.

3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.

4. Our Editors will be glad to answer any letter at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editors a personal favor if you make your letter as brief as possible.

WAVELENGTH OF COUPLER.

(75) Joseph Griffin, Jr., Brooklyn, N. Y., asks:

Q. 1. Please publish in your magazine under "I want to know," the wavelength of the following: (a) Loose coupler (primary) 5 inches in diam. wound for 11 inches with No. 22 enamel wire (secondary) 4½ inches in diam wound for 11 inches with No. 30 enamel wire. (b) If cotton or silk covered wire were used would it increase the wavelength?

Q. 2. Please state the name of a book that describes the construction of loading coils and loose couplers.

A. 1. (a) 3500 meters; (b) no, it would slightly decrease the wavelength.

A. 2. How to Make Wireless Receiving Sets, published by the Experimenter Pub. Co., 231 Fulton St., New York City, for 25 cents.

RADIO CIRCUITS

(76) Chas. Hackett Monroe, Atlantic City, N. J., wants to know:

Q. 1. Kindly tell me through your information column if the circuit (c), on page 120 of the September RADIO AMATEUR NEWS employs a plain double slide tuner or a special wound coil.

Q. 2. What would be the telephone range of this set using a V.T.1 with 22½ volts on the plate?

A. 1. Yes, this coil in the form of a double slide tuner will do.

A. 2. You would most probably have to use a high voltage on the plate circuit for radio telephone work—about 5 miles.

SHORT AND LONG WAVE RECEIVER

(77) Vincent Tassie, New York City, asks:

Q. 1. Will you please publish in the "I Want to Know" columns of the RADIO NEWS a short wave regenerative hook-up for the following instruments: 1 loose coupler for up to 1500 meters, one .001 mf. variable, one .0005 mf. variable, one grid fixed condenser of correct capacity, and an audiotron bulb. I also have wire for any extra coils or variometers necessary. I should also like you to show, with dimensions of loading coils, etc., how I could change over this hook-up from the short wave regenerative to long wave (up to about 6,000 meters), dampt and undampt. I intend to construct a cabinet with these instruments, and would be very glad if you will publish the hook-up and thus help me out very much.

A. 1. The circuit you request is printed elsewhere in our magazine in the text of article entitled "A Short Wave Receiver of Novel Design for the Amateurs," in the October issue. You of course have this copy on hand, being a subscriber.

SPLITDORF COIL FOR SENDING

(78) Robert H. Priebeg, Woodhaven, L. I., desires to know:

Q. 1. I have a "Splitdorf" spark coil in good condition, taken from an automobile. I'd like to know if it is possible to hook-up a vibrator with it, and use it for transmitting wireless messages?

A. 1. Yes, if you are familiar with the correct procedure necessary to put the vibrator in its proper place.

ANTENNA WAVELENGTH

(79) Orion G. Albert, West Philadelphia, Pa., asks:

Q. 1. I would like to know the wavelength of an aerial 40 feet high and 50 feet long, consisting of 4 wires of No. 14 copper wire?

Q. 2. Also the approximate distance I could receive using a galena detector, a double slide tuning coil and a fixed condenser; using 2,000 ohm phones with the above aerial?

A. 1. 125 meters.

A. 2. You should be able to receive 500 miles on the day time and double or treble that distance at night.

Radio Articles in November issue Electrical Experimenter

Radio Between Submarine, Airplane and Destroyer.

New Kolster Decremeter and Wavemeter.

Improving the Amateur Receiving Set, by E. T. Jones.

A Loose Coupler Wrinkle, by Thomas Reed.

CALL LETTERS ON GREAT LAKES

(80) E. Wendell, Barnard, N. Y., asks the following:

A. 1. I have a 5-bar generator. What is necessary to rig this up with to run a transformer for wireless transmission, or what is necessary where I do not have an A.C. supply?

Q. 2. Give natural wavelength aerial 2 wires 140 ft. long, 5 ft. apart, 50 ft. one end, 30 other, 20 ft. lead, 20 ft. ground copper wire No. 10?

Q. 3. Advise where I can learn names of boats on Great Lakes that I hear?

A. 1. A generator constructed from the magnets you have would not produce enough current to operate a wireless transformer. It will be necessary for you to purchase a gas engine generator outfit with an A.C. generator, or if you have a direct current supply, then a motor generator set comprising a direct current motor and an A.C. generator.

A. 2. 100 meters.

A. 3. From a radio call book published by the Consolidated Radio Co., 41 Park Place, New York City.

VACUUM TUBES ON 110 D.C.

(81) W. G. Voss, Brooklyn, N, Y.. wants to know:

Q. 1. Would you kindly let me know whether it is possible to operate an audion detector on the house lighting current by using some suitable resistance to cut down the current, where only D.C. may be had.

Q. 2. Could this be done by using a high resistance potentiometer?

Q. 3. If not, what kind of resistance would be suitable?

A. 1. Yes, this is possible by employing a pupin coil and large condenser connected as shown in past issues of the *Electrical Experimenter*. This circuit takes out the ripples in the circuit and commutator noises.

A. 2. Yes, if you refer to diminishing the current supply.

A. 3. See above.

LOADING COIL

(82) A. H., Brooklyn, N. Y., asks:

Q. 1. Would I get better results by using No. 24 wire for a loading coil for the primary and No. 30 for the secondary or No. 24 for both the primary and secondary?

Q. 2. What would be the wavelength of a loading coil made of No. 24 wire wound on a tube 4½ inches in diameter and 12 inches long?

A. 1. Yes, use No. 24 for the primary and No. 30 for the secondary.

A. 2. 2,000 meters.

BUZZER TRANSMITTER DATA.

(83) B. G. Silberstein, Duluth, Minn., wants to know:

Q. 1. Give data for buzzer transmitting set.

Q. 2. Is NAJ undampt?

Q. 3. Does NAA ever send dampt waves besides when it is sending time?

A. 1. A buzzer transmitter will work up to five miles on a suitable antenna if connected as shown in the following diagram after Mr. Jones' article printed in the July issue.

A. 2. NAJ sends on dampt and undampt.

A. 3. Sometimes this has been done, but was not found to be necessary.

ANTENNA WAVE LENGTH.

(84) C. W. Taylor, Allston, Mass., asks:

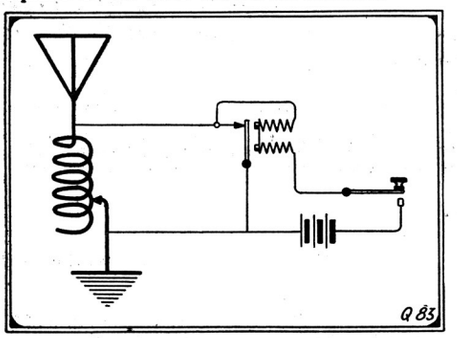
Q. 1. Please answer the following question in the "I Want to Know" column of the RADIO AMATEUR NEWS. What is the natural wave length of my aerial? It is 20 ft. high, 40 ft. long and has 5 wires 1½ ft. apart with a lead in of 8 ft.

A. 1. Approximately 100 meters.

LOOP ANTENNA.

(85) Fred G. Maner, Ridgwood Queen, N. Y. C., desires the following information:

Q. 1. Please publish the following in your "I Want to Know" columns. What size wire should be wound on a square solenoid loop antennæ 2 ft. 10¼ inches square or 11 ft. 5 inches all around?



Showing how a buzzer may be used for transmitting.

Q. 2. What is the proper spacing for the above loop?

A. 1. No. 18 annunciator wire can be employed.

A. 2. One-quarter inch.

WIRELESS TELEPHONE SET.

(86) W. A. Canfield, Luverne, Minn., asks the following:

Q. 1. What are the dimensions of the coils, the voltage of the "B" battery, the capacity of the variable condenser and the type of microphone shown in the wireless telephone diagram on page 103 of the September R. A. N.?

Q. 2. What is the approximate range of this set, using an aerial 100 feet long and 50 feet high?

A. 1. A short wave loose coupler will do with a tickler coil or coupling coil, as shown, 100 volts D.C., an ordinary transmitter employed for telephone work.

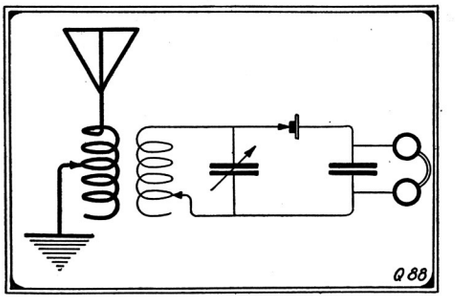
A. 2. Approximately five miles.

EXCEPTIONAL RECEIVER QUERY

(87) Geo. L. Rhoads, New Haven, Conn., wants to know:

Q. 1. In your August issue of Radio Amateur News you publisht an article entitled "An Exceptional Radio Receiver." On page 63 it says the primary two and one-half inches long and is wound for two inches with a double bank of No. 24 D.C.C. wire. I wish you would please explain the meaning of the phrase "double bank" as used in this article. Does it mean a double layer? Please let me know as soon as possible, as I am constructing a set similar to the one described.

A. 1. The meaning of double bank winding is a double layer of wire, "banked." This is shown in the drawing below.



Here is the best hook-up for your apparatus.

WAVE LENGTH OF COILS.

(88) Alex O'Hare of Chicago, Ill., wants to know:

Q. 1. What wave length will a loose coupler of the following dimensions tune to with an aerial 50 feet high and 65 feet long, two-wire: Primary 4½", dia. 8" long, wound with No. 27 D.C.C. wire; secondary 3½" dia., 12" long, wound with No. 31 D.C.C. wire?

Q. 2. What is the hook-up of the following instruments: 1 loose coupler, 1 Murdock loading coil, 2 E. I. 43 plate var. condenser, 1 galena detector, 1 Murdock fixed cond., 1 Turney 3,000 ohm head set?

Q. 3. What is the receiving range of the above set?

A. 1. Approximately 4,000 meters.

A. 2. A good hook-up is given below.

A. 3. About 500 miles during day time and triple that distance at night.

RECEIVING RANGE.

(89) Arthur Tabraham, Bloomington, Ill., asks:

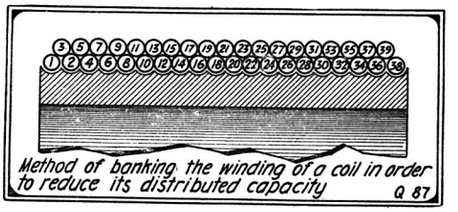
Q. 1. Please publish in "I Want to Know" the wave length of the following: Load coil (A) 18½" by 3", No. 30 S.C.C.; load coil (B) 20" by 4", No. 32 enameled wire; coupler prim. 4", diam. 140, turns No. 24. sec. wound 6", 3½" diam., No. 30 S.C.C.

Q. 2. Would the wave length of the set be increased by placing load A inside load B in the form of a coupler? Which load should be used as primary and which as secondary?

Q. 3. What is approximate range of the set using audion and 95-foot aerial 40 feet high at one end and 25 feet at other end?

A. 1. "A" 2,500 meters, "B" 3,200 meters. Coupler will respond up to 4,000 meters.

A. 2. Yes; but the size wire employed is not very good for the primary. At all times the larger size wire is employed for the primary.



This explains the meaning of "double bank."

A. 3. You should be able to cover distances up to several thousand miles using an audion.

RECEIVING RANGE OF SET.

(90) Elmer H. O'Neill, Sr., Dauners Grove, Ill., asks:

Q. 1. How far can I receive on the following (also the number of meters)? (a) 1 Resco. naval loose coupler 18¼" long, about 2,000 meters, one slider and a 10-point secondary winding. (b) One .005 m.f. variable condenser (Murdock). (c) Silicon detector (a very small one). (d) One large Murdock fixed condenser. (e) One pair of 2,000-ohm Murdock head set phones. (f) Aerial is 4 wires 2½ feet apart 50 feet long and about 25 feet high. (Note: I live on a very high hill.)

Q. 2. What changes and additions would improve this outfit?

A. 1. You should be able to receive about 400 miles during daylight; however, this distance will be doubled during night reception.

A. 2. By introducing an audion bulb in your detector circuit or an amplifier connected in where the phones are now connected.

WAVE LENGTH OF TUNER.

(91) C. W. Kress, of Rochester, N. Y., wants to know:

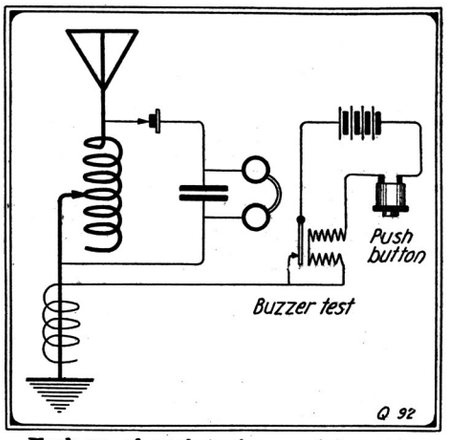
Q. 1. What is the wave length of a double slide tuning coil 3" in diam. and 15" in length and wound with No. 22 single cotton covered copper wire?

Q. 2. How far and what stations can I receive with the following instruments: A Murdock fixed condenser, a Murdock silicon detector and a tuning coil described above and a 75-ohm receiver connected to a 300-foot one-strand wire?

A. 3. Circuit is given herewith.

A. 1. 3,000 meters.

A. 2. Approximately 500 miles.



Hook-up of pocket sign receiving sets.

POCKET SIZE RECEIVING SET.

(92) Nicholas S. Metri of Chicago, Ill., inquires:

Q. 1. Please give a hook-up of the pocket receiving set, described in the September issue of Radio News, including a 43 plate "variable" condenser, a loading coil 3 inches in diameter by 6 inches in length, wound full of No. 24 D.S.C. wire and tapped off every fifty turns.

Q. 2. Describe the possibilities of this set, with a medium sized aerial.

Q. 3. Please give some good suggestions as to size of loading coil with wire and whether it would be better to enlarge the receiving transformer. If so give all the dimensions.

A. 1. Hook-up is given in the drawing elsewhere in these columns.

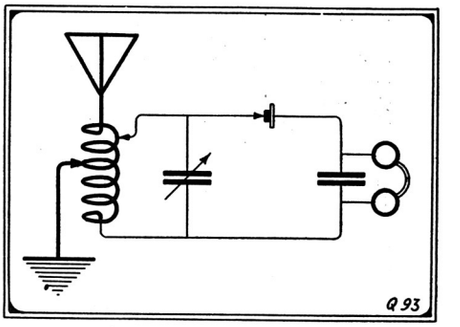
A. 2. This all depends on the sensitivity of the crystal employed and at what precision the set is adjusted. Actual experiment is the only solution.

A. 3. This set is not intended for long wave lengths, therefore it is not necessary to provide load coils, for then the object of the set will be defeated, since it is intended for the pocket.

VARIABLE CONDENSER QUERY.

(93) E. Culver, North Baltimore, Md., wants to know:

Q. 1. How far can I receive with the following instruments: Pair 2,000-ohm phones, one fixed condenser, one galena detector, and a two-slide tuning coil, 15 in. long and 4 in. in diameter, on an antenna 60 feet long and 30 feet high.



Placing the variable condenser across the tuning coil increases the wave length.

Q. 2. How can I hook up a variable condenser with this set to increase its wave length?

Q. 3. Give a diagram of the best way to hook-up this apparatus.

(*Continued on page* 259.)

The Three Electrode Vacuum Tube

By Prof. W. H. Eccles

(*Continued from page 217.*)

If any one tries the experiment just indicated to find what order of magnification is obtained by the sub-generative method, he will discover that, on passing gradually from this adjustment to the oscillating condition, other phenomena arise. If the incoming oscillations which he is trying to magnify are unceasing and uniform, and of nearly the same audible frequency as that natural to the oscillator, he will find that a throbbing appears in the formerly steady musical note of the telephone. The throb appears only when the input current is really being introduced into the oscillating system, and is more marked the greater the original strength of the current that is to be magnified; but the input necessary to produce a perceptible amount of throbbing is exceedingly small. It would seem that the input current, when it reaches the grid, becomes magnified, first by the more ordinary process of the triode, and then combines with the local oscillations to produce what the musician calls "beats," and then the beats are themselves magnified by circuits of the triode.

As carried out in wireless, the operator at a receiving station sets his apparatus near the wave length he desires to receive, and then causes his triode to sustain his circuits in oscillation. The waves from the distant station, acting upon his antenna, produce minute currents in the antenna which are transformed so as to apply an electromotive force to the grid of the triode. The result is an audible note in the operator's telephone each time the key of the transmitting station is depressed, provided, of course, the frequency of the receiver is near enough to that of the incoming waves. He can adjust the local frequency at will, and make it very near to the waves or very different from them; these adjustments alter the pitch of the beat note, and he chooses the more agreeable and efficient setting for the reception in hand. This process of receiving continuous wave signals on an oscillating circuit is called autoheterodyne or, sometimes, endodyne reception. Circuits can be designed in which a change of capacity of about one-thousandth part of the electrostatic unit can be detected; and in such circuits the change of capacity produced, for instance, by substituting coal gas for air in a condenser, is measurable with faculty.

Lecture delivered before the British Association meeting at Bournemouth, England.

170-25000 Meter Receptor

By F. R. Pray

(*Continued from page 221.*)

The split-condenser box with *Arc-Spk.* switch should have a height sufficient to bring the secondary condenser up to a level with the primary condenser. The sides may be made of scrap pieces of hard rubber or Bakelite. The general construction of the switch is shown in sketch; the end of blade bent at an angle, to give a "wiping" contact.

The most convenient condensers for this method of tuning are the small and large Murdock Variables. The De Forest Hon-

AN OPEN LETTER TO ALL RADIO MEN

WM. J. MURDOCK CO.

MANUFACTURERS OF

WIRELESS APPARATUS

CHELSEA, MASS.

October 1, 1919

Gentlemen:

The first MURDOCK receivers for radio use were produced in 1904, their introduction being coincident with the first signs of interest in experimental radio telegraphy.

In reviewing a record of fifteen years of production, beginning with a few sets virtually built to order, and growing to the present output of thousands, there is a real satisfaction in the knowledge that these receivers have come to be universally recognized as desirable additions to the experimenter's outfit. No volumes of persuasive advertising, nor no piling up of boastful claims could achieve such a permanent success as this. The real cause of the success depended upon the receivers themselves.

These fifteen years of steady growth in the esteem of the leading radio experimenters of the United States is the best assurance of the value of MURDOCK receivers, and is, moreover, a true pledge, for the future, of the satisfaction of those who have not as yet become acquainted with their worth.

Sincerely,

Wm J Murdock

THE QUALITY IS UNUSUALLY HIGH
THE PRICES ARE REMARKABLY LOW

2000 OHM Double Set
$4.50

3000 OHM Double Set
$5.50

Sold with the usual "MONEY BACK" guarantee. To be sure of getting your set, ORDER NOW.

BULLETIN 19B showing the complete MURDOCK line of really good radio apparatus, sent free on request.

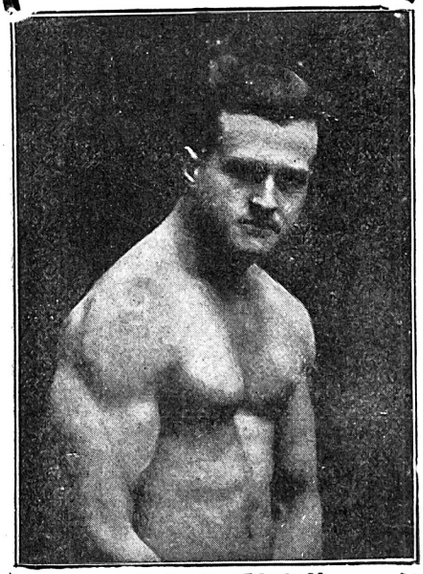
WM. J. MURDOCK CO.
50 Carter Street
CHELSEA, MASS.

509 Mission St., San Francisco, Cal.

You are Judged by Your Appearance

The world sizes you up by your own opinion of yourself—as expressed in your looks, your actions, and the force of your ambition. Look at the photographs of any of the world's business leaders. Note that clean-cut, sharp, alert look in each one's eyes, the firm tilt to the head and chin, the square set of the shoulders. It's the strong, virile man, the man of tireless energy, that gets to the top.

You can't be alert, you can't have full control of your faculties, you can't have that inexhaustible supply of vitality and energy that mean success in life unless you have PERFECT HEALTH. Your physical condition is the root of your whole life. Build up your body and muscular strength and you build up your mind and vitality and insure success.



EARLE LIEDERMAN

The Acme of Physical Perfection

There is a Short-cut to Health

I have found it and applied it to my own body and proven its results. And I have trained many of the world's strongest men by this same method—taken them when they were mere physical wrecks and made powerful athletes of them. I can do the same for you. No need for you to drift aimlessly along—merely existing. Get a grip on yourself. Resolve right now to start on the road to success—the first step of which is better health.

Send for MY NEW BOOK

"Muscular Development"

It tells the secret. Handsomely illustrated with 20 full page photographs of myself and some of the world's best athletes whom I have trained. Also contains full particulars of my splendid offer to you. The valuable book and special offer will be sent on receipt of only 10c, stamps or coin, to cover cost of wrapping and mailing.

Don't miss this opportunity. Sit right down now and fill in the coupon. The sooner you get started on the road to health the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon today.

EARLE E. LIEDERMAN

Dept. 904, 203 Broadway, New York

Earle E. Liederman
Dept. 904, 203 B'way, N. Y. C.

Dear Sir:—I enclose herewith 10c, for which you are to send me, without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write or print plainly.)

Name .....

Address .....

City..... State.....

R. \ v. 1919

eycomb inductances are fastened to the condensers with Colburn plug adapters, which are sold by the Somerville Radio Laboratory. This method of mounting does away with leads, allows practically any degree of coupling, and is cheaper than the regular mounting. Since the data on the proper selection of Honeycomb coils is given in the De Forest catalog, it will not be repeated here.

Many long wave stations require very loose coupling between the primary and secondary circuits; in fact, as much as a foot is sometimes used. Hence, mechanical connections between the primary and secondary would be out of place. With the coupling device shown in sketch, the coils may be placed at right angles, as far apart as the flexible lead will permit, or so close that they will touch one another. It is surprising how convenient this method of coupling is, especially if this section of the table is covered with a square of plate glass. Besides furnishing a good sliding surface for the variable, it gives a good writing surface for copying messages. Furthermore, operating data of important stations may be placed underneath for easy reference. This is also a good place for Honeycomb coil data, and characteristic curves of your vacuum tubes. The glass may be purchased from plate glass window concerns who obtain it as salvage from broken windows.

The primary variable is to be connected to the antenna change-over switch by a flexible cord, which may be made as follows, to a length of one or two feet. Fasten ten or so strands of small magnet wire, say number 34 to 38, in the chuck of a small "eggbeater type" drill, with the other end to some projection such as a nail, and twist until the cord makes one complete twist for each inch of length. The cord is then cut in three pieces and braided in the usual way. (Any girl will show you how.) Of course, two of these braided cords will be needed. In order to protect the insulation, the two cords are placed in a length of ½ in. I. D. rubber tubing, and separated by pressing the tubing out flat, filling with rubber cement, and vulcanizing with a flat iron or warm soldering iron, as shown in small sketch. The ends of the conductors are then cleaned of their insulation and dipped in solder, to prevent their unravelling.

For those wishing to build their own fixed condensers, the following data will not be amiss.

$$C = \frac{A\ K}{4\ T\ 900{,}000}$$ = capacity in microfarads.

A area in sq. centimeters.

T thickness of dielectric (cms.).

K constant (5, when using mica).

Two sheets of copper or aluminum foil, each having a total active surface of sixteen sq. in., separated by a dielectric of sheet mica, 1/100 centimeters thick, will have a capacity of .0005 M. F. However, the majority of amateurs, lacking micrometer calipers for measuring dielectric thickness, will have to arrive at the precise capacity by varying the area of the plates. Both parts of the split condenser should be identical, but not exactly the exact capacity prescribed. A variation of .0001 either way is not harmful to the best functioning of the circuit.

PAPER TUBES

AT ATTRACTIVE PRICES

Special made, smooth, round, seamless, gray cardboard tubing in selected sizes for constructing loose couplers, variometers, loading coils, etc.

FOR 3500 METER COUPLER

Primary 3¾" outside dia. 7" long—25c
Secondary 3¼" outside dia. 6" long—20c

FOR VARIOMETERS

Primary 4¾" outside dia. 2½" long—12c
Secondary 3¾" outside dia. 2" long—10c

FOR LOADING COILS

3¾" outside dia. 14" long—40c
4¾" outside dia. 14" long—50c

Special Lengths Cut to Order

To 15" long 3¼" dia.—4c per in.
3¾" dia.—5c per in.; 4¾" dia.—6c per in.
All tubes have ⅛" wall.

LABORATORY SIGNS

Attractive 8" x 10" signs

printed on high quality coated white cardboard in selected wordings for the electrical experimenter.

1. DANGER! HIGH VOLTAGE
2. Experimental Radio Laboratory No Admittance
3. Government Licensed Radio Station
4. Do Not Touch the Instruments
5. Please Be Quiet While The Operator is Receiving

15c EACH, ANY TWO FOR 25c
ALL 5 FOR 50c
IMMEDIATE SHIPMENTS, POSTPAID

The TAYLOR COMPANY
Box 1043 B
Lowell, Mass.

The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

An Ideal Christmas Gift For Men

VIBRATING ELECTRIC RAZOR CO.
Dept. 145, Omaha, Nebr.

INDUCTANCE WINDING **W. SIEGERT** WOOD PATTERNS

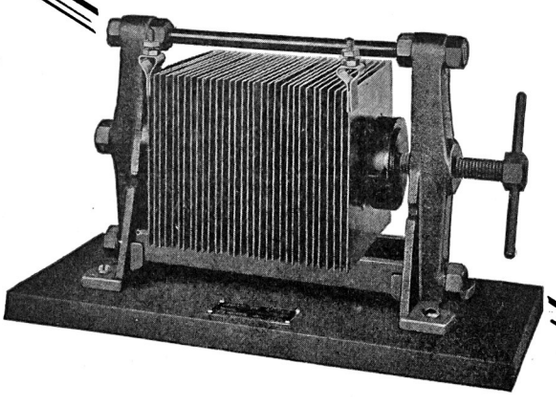
1250 W. 97th Pl.
CHICAGO, ILL.

Special Radio and Electrical apparatus built to order

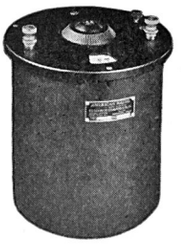
Electrical Experimental Work

Write for Estimates—I Will Save You Money

Other AMRAD *products that every amateur should use are:* AMRAD *Detector Stand,* AMRAD *Antenna Switch,* AMRAD *Induction Coil—for use where AC is not available. Ask your dealer about* AMRAD *products, the commercial grade apparatus for amateur use.*

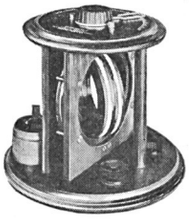


AMRAD
Quenched Gap
$17.50



AMRAD
Variable Air
Condenser

AMRAD
Detector
Stand



AMRAD
Variometer

Now that the ban is off—

There will be more severe government restrictions imposed than ever before.

To secure *three to four times your present antenna energy,* to assure low decrement and so comply with government regulations, amateurs should use the

AMRAD

QUENCHED GAP

The AMRAD Quenched Gap does not necessitate the use of 500-cycle generator. Properly operated with a 60-cycle circuit, it will give a 240 spark note.

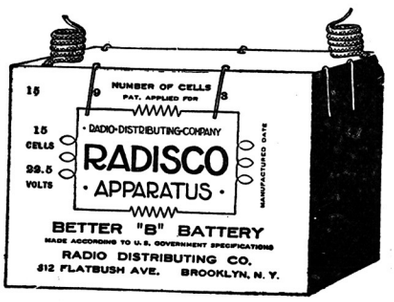
Our bulletin No. 12, sent at your request, will explain how this may be done.

Folder, giving detailed specifications of the Quenchea Gap will be sent at your request. Address Department R 5.

AMERICAN RADIO AND RESEARCH CORPORATION

21 PARK ROW **NEW YORK**

Factory at Medford Hillside, Mass.



BETTER "B" BATTERY

The RADISCO BETTER "B" is guaranteed to be manufactured in accordance with U. S. Government specifications and is sold on a money back basis. Among the many reasons it is better are:

VARIABLE VOLTAGE

This feature alone (on which a patent has been applied for), makes the RADISCO BETTER "B" the battery you will eventually buy. Considerable has been written about vacuum tubes that do not require critical voltage regulation, but the fact still remains that the vacuum tube used by the majority of experimenters requires plate voltage regulation. To provide this regulation, taps have been taken off the 1st, 2d, 3d, 6th, 9th, and 12th cells, (see illustration) and it is only necessary to connect these to a switch to provide critical voltage regulation for your tube.

ECONOMY

With the ordinary 15 cell battery, when one cell goes "bad," the entire battery must be discarded. With the RADISCO BETTER "B" you only need test each group of three cells, and short circuit the group containing the "bad" cell.

LOW PRICE

The price of the BETTER "B" is the lowest at which it is possible to sell a first class 15 cell battery.

BETTER "B" No. 1,
Size 3¼x2x2½ inches, $1.15
Postpaid 1.25
In Canada, add 35c

BETTER "B" No. 5,
Size 6½x4x3 inches, $2.25
Postpaid 2.60
In Canada, add 50c

RADISCO AGENCIES

The BETTER "B" battery is only one of the many articles of standard radio apparatus carried by RADISCO AGENCIES. These Agencies are the leaders in the Radio Field in their locality. It will pay you to communicate your wants to them.

ALBANY, N. Y.
E. L. Long
21 Magnolia Terrace

ATLANTIC CITY, N. J.
Independent Radio Supply
118 So. New Jersey Ave.

BIENVILLE, QUE., CANADA
Canadian Radio Mfg. C.

BOSTON, MASS.
Atlantic Radio Company
34 Batterymarch St.

BROOKLYN, N. Y.
Kelly & Phillips
312 Flatbush Ave.

BRONX, NEW YORK CITY
Amateur Wireless Equipment Co.
1390 Prospect Ave.

CHICAGO, ILL.
Chicago Radio Laboratory
1316 Carmen Ave.

McKEESPORT, PA.
K. & L. Electric Co.
427 Olive St.

NEWARK, N. J.
A. H. Corwin & Co.
4 W. Park St.
(Note new address)

NEW ORLEANS, LA.
L. A. Rose
4323 Magnolia St.

PITTSBURG, PA.
Radio Electric Co.
4614 Henry St.

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington St.

SCRANTON, PA.
Shotton Radio Mfg. Co.

WASHINGTON, D. C.
National Radio Supply Co.
1405 U Street, N.W.

If none of the above agencies are in your vicinity communicate direct with the

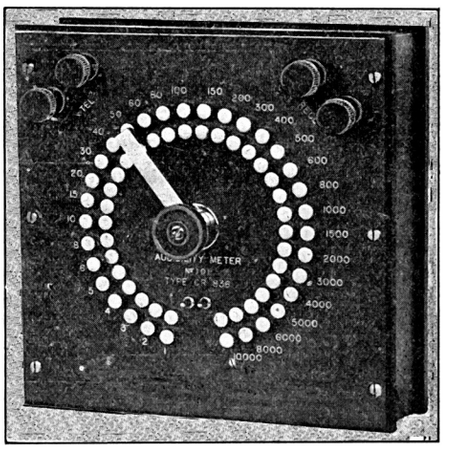
RADIO DISTRIBUTING CO.
NEWARK, N. J.

A Constant Impedance Audibility Meter

By WALTER HENRY

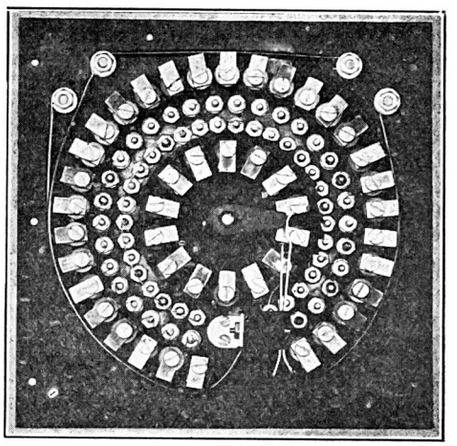
(*Continued from page* 216.)

rent passing through the shunt, we could readily determine the number of times audibility of the signals, providing at the same time we introduced an impedance in series with the detector output, so as to maintain the total impedance across the detector constant.

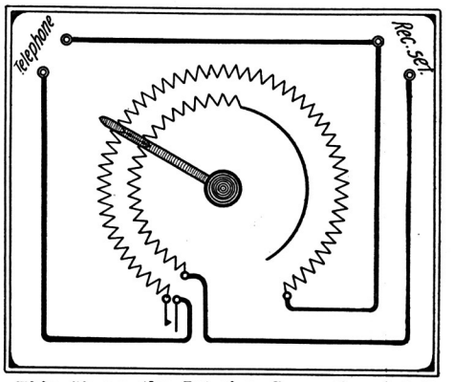


The Constant Impedance Audibility Meter. Note the Arrangement of the Switch Contacts.

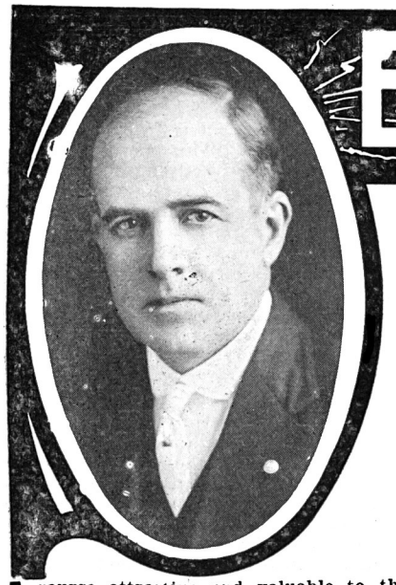
In the old types of audibility meters, inaccuracy was introduced in the readings because of the variation in the total impedance across the detector, which resulted in a variation in detector output. The constant impedance audibility meter maintains a constant impedance across the detector



Rear View of the Audibility Meter Panels.



This Shows the Interior Connections of the Meter.



ELECTRICITY

Taught by a Practical Man—and In Your Home

I AM teaching electricity and drafting to many men, young and old, and wish to interest you sufficiently so that you will send for my catalog which tells the whole story regarding my method of instruction and the good which is being accomplished. It is up to you whether you look into this proposition, but if you are in earnest in your desire to get into the electrical industry, or to become more proficient in that line, you will send for my catalog and not regret the time you give in doing so.

THE PURPOSE OF THE COURSE OF STUDY

I have been designing courses in electrical instruction and teaching electricity, off and on, during the past 17 years, and during that time I have had an unusual opportunity to make a special study of the teaching business, from the standpoint of a practical man. This course has been designed by me with a view of reaching those who do not have a lot of time and money to devote to study work and to give them as thorough a knowledge as possible of electricity as applied to every day practical work. The instruction is given like you were working on various jobs and I tell you what to do and how to do it, giving the necessary explanation for the understanding of the theory covered by the subject under discussion. Another particular feature of my instruction is that I lay particular stress on the unusual conditions which seldom happen in the every day run of electrical work, and this part of the instruction makes the course attractive and valuable to those already engaged in the electrical industry and accounts for the fact that over 65 per cent. of my students are practical men.. Among my students are beginners, electricians, foremen, maintainers, repair men, armature winders, power-house helpers, power-house foremen, Navy electricians, Chief Navy electricians, chief electricians, Chief City Electricians and Contractors. These men are taking my course and find my instruction and my help of value to them. Not only are they satisfied, but they are sending me more students. In several places I have nearly all the men in the plant taking my work together.

FIFTY-FIFTY

I work absolutely on a 50-50 basis with my students and my method of handling their instruction and my dealings with them have never been criticised. You pay me the comparatively low price I ask and I give you the instruction and other help as stated in my catalog. No student is permitted to pay cash for his entire course on starting, the course being paid for in small monthly payments as you go along. Students have the privilege of discontinuing the work if they should find that it was not just what they were after and their payments stop at the same time. This is my way of doing business and a part of my 50-50 plan, as I would not want your money when I was not giving you the instruction.

Apparatus, Instruments, Materials, Etc.

Certain electrical apparatus, instruments, materials, charts, drafting materials, etc., as described in the catalog, are included as a part of the course for which there is no extra charge, as it is covered by the regular monthly payments.

Fill Out Coupon or Drop Me a Postal Card For One of My Catalogs Which Gives Full Information.

BURGESS ELECTRICAL SCHOOL
750 E. 42d Street Chicago, Ill.

Yorke Burgess, Burgess Electrical School,
750 East 42nd Street, Chicago, Illinois.

Gentlemen:—

Send me catalog describing your course in Electricity and Drafting.

NAME .....

ADDRESS .....

CITY .....STATE .....

The Burgess BLUE BOOK

for all Practical Men and Electrical Students

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

This book is recommended by practical men.
It is being used in technical schools.
Electrical establishments furnish them to their employees to save time.
Industrial establishments give them to their customers.

The Burgess BLUE BOOK Will Be Mailed, Postpaid, on Receipt of $1.00

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days.

BURGESS ENGINEERING CO., YORKE BURGESS, Consulting Engineer
745 East 42nd Street Chicago, Illinois

RADIO APPARATUS

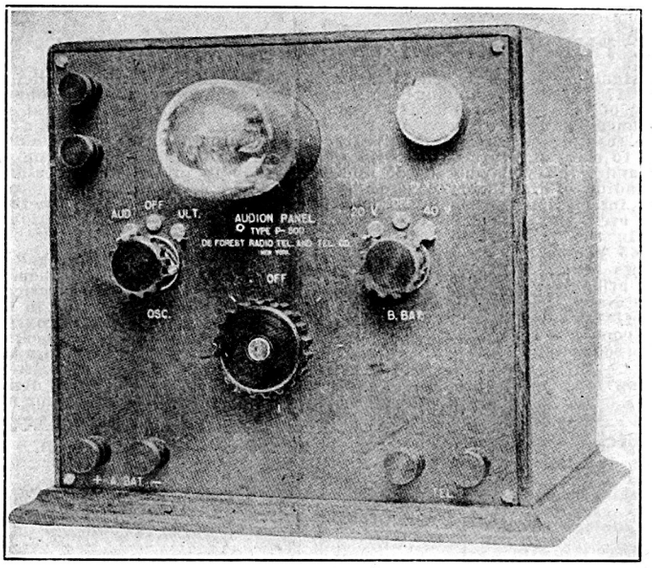
DISTRIBUTORS OF ALL PROMINENT MAKES:

De Forest, Wireless Specialty, Murdock, Grebe, General Radio, Clapp-Eastham, Brandes, Acme, Arnold, Federal Tel. & Tel. Co., etc., etc.

LARGEST AND BEST STOCK OF ANY HOUSE IN NEW ENGLAND.

Just place your orders with us direct from any of the above catalogs. You will appreciate our service.

Type P-500 DeForest Audion Ultraudion Panel

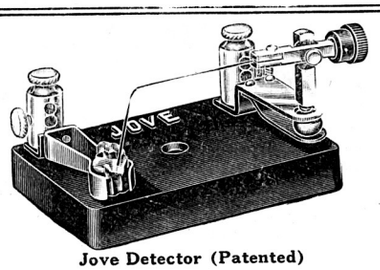


Audion-Ultraudion Panel with 20-40 volt B Battery and Oak Cabinet, "Early English" finish without the tube.
Price, **$24.00.** Shipping weight, 13 lbs.

All orders shipped the same day. Give us a trial.

F. D. PITTS CO., Inc.

12 Park Sq. **Dept. C** **Boston, Mass.**



Jove Detector (Patented)

Bunnell Instruments Always Satisfy---

Our Jove Detectors Simplest and Best--

Sample by Mail, $1.44.

Tested Galena Crystals, 25c per box.

Our Condensers, Transformers, etc., are High Grade, but inexpensive.

Send stamp for our New Catalog 40 R.N.

J. H. BUNNELL & CO. **32 Park Place, New York**

(Marconi Licensee)

EASTERN RADIO INSTITUTE

TEL. BACK BAY 5964

699 Boylston St. Boston - Mass.

Tremendous demand for Wireless Operators! Splendid opportunities now in the Merchant Marine. Big salaries! Junior operators, $100 per month, Chief operators, $125, food and quarters included. Our Graduates in all parts of the world as operators, instructors, inspectors, engineers, etc., etc. Let the Eastern Radio Institute train you because we have never yet failed to secure a graduate a position. DAY AND EVENING CLASSES. START ANY MONDAY. Send for prospectus.

terminals, which is equal to the impedance of the telephones and insures a constant detector output in all adjustments. This meter is designed so that this constant impedance is automatically secured. The range of the instrument is from one to ten thousand audibility. This meter is invaluable in measuring the strength of signals in comparing the receivers, receiver circuits, telephones, and the amount of amplification in oscillating currents, and other laboratory and commercial measurements. It can be left connected in the circuit without a reduction or signal strength, when the contact switch is on one. It may be used with equal success in either vacuum tube oscillating currents or with crystal detectors and reads directly in "times audibility."

The meter is beautifully furnished in a hard wood box, with a bevelled bakelite dilecto top, on which the audibility is directly engraved. Connection is readily afforded by four binding posts, two for the receiver circuit, and two for the telephone. The tubes and contact arm are of polished nickel, so that the instrument makes an invaluable and attractive addition to any radio station or laboratory.

A (TRUE) HARD LUCK STORY

'Twas in the memorable spring of 1917.

We three—Zabolitzki, Zankl and myself, fellow students—started one afternoon on a little expedition we'll likely ne'er forget. The portable set belonging to 9ACA was to be tried out.

Our destination was a point on the other side of the lake, about a mile by Radio. There was too much ice on the lake to make it safe with a boat, so away we trudged, through mud and slush, only two miles to go. Two of us lugged along the heavy storage battery, the other had the grip containing the rest of the junk. An hour's walk brought us to the end of our excursion; half an hour more, and the

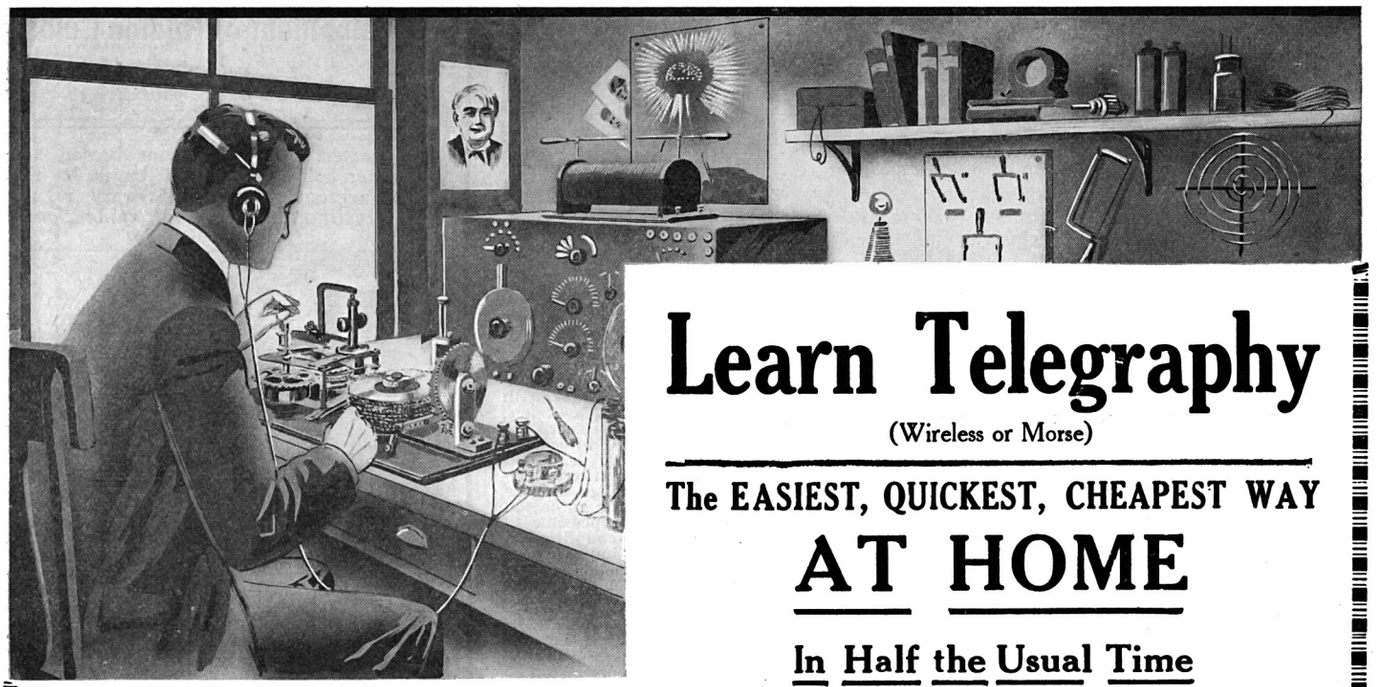
A minute later we watched his hand spell out the first message ever received on that portable set.

aerial was safely spread between two oak trees, and the set ready for business.

Zankl grabbed the key, and the coil sputtered out: 9ACA 9ACA 9ACA de 9ACA Jr. 9ACA Jr 9ACA Jr. .—.—. .—.—.

He threw the switch to "receiving" and a minute later we watched his hand spell out on paper the first message ever received on that portable set: 9ACA Jr 9ACA Jr 9ACA Jr de 9ACA 9ACA 9ACA: Just got orders from Govt. to dismantle station immediately. Pack up and come home. 9ACA 9ACA .—.—. Motto: When the Government puts a ban on Radio, don't rig up any sets.

Contributed by HERBERT RICHTER.



Learn Telegraphy

(Wireless or Morse)

The EASIEST, QUICKEST, CHEAPEST WAY

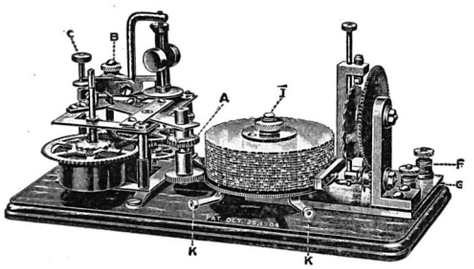
AT HOME

In Half the Usual Time

WITH THE OMNIGRAPH

"Just Listen—The Omnigraph will do the teaching"

The Omnigraph is an *Automatic* Transmitter that teaches you both the Wireless and Morse Codes, at home, without any expense except the cost of the machine itself. Merely connect to battery and your Buzzer, or Buzzer and Head Phones, and the Omnigraph will send unlimited messages by the hour, *at any speed* you desire.



USED BY THE U. S. GOVERNMENT

The Omnigraph is used by the Government in testing all applicants applying for a Radio License. It is also used extensively by the large Universities, Colleges and Telegraph Schools throughout the Country for teaching Wireless and Morse.

Hundreds of the Army's skilled operators who served during the war learned with the Omnigraph.

Let The OMNIGRAPH Teach You Wireless

For a few dollars you can have a complete outfit that will make you an experienced operator in the shortest possible time. No hard, laborious work — just learn by listening. The Omnigraph is adjustable so you can start receiving messages slowly, gradually increasing the speed as you become proficient.

You'll be surprised how quickly you will attain speed. Even if you are already an operator the Omnigraph will help you. It will make you more proficient, more accurate and more confident. Thousands of Omnigraphs are in use to-day and thousands of operators owe their success to them.

Write for Free Catalog

Send for a catalog to-day, showing the 3 different models, $12.00 to $28.00. Every Omnigraph is sold with the absolute guarantee that you must be satisfied or your money back for the asking. Mail the coupon to-day — the catalog will come to you by return mail.

The Omnigraph Mfg. Co.

39 F Cortlandt Street - NEW YORK CITY

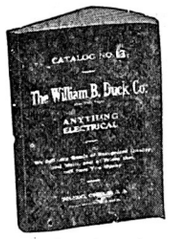
The Omnigraph Mfg. Co.,
39 F Cortlandt St.,
New York City.
Gentlemen:—

As per your ad in Radio Amateur News please mail me your free catalog of Omnigraphs.

Name .....

Address .....

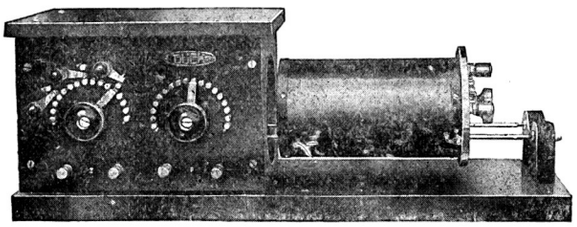
City ..... State .....



DUCK'S New Big 264-Page Wireless and Electrical Catalog Just Out

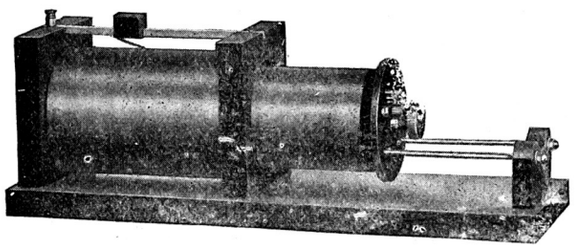
It is mailed for 12c in stamps or coin which may be deducted on first order of $1.00. Catalog not sent otherwise.

We regard this catalog as our greatest effort. It embraces everything in wireless worth while. 172 pages with no waste space devoted exclusively to wireless instruments. Your amateur friend will tell you that there never has been any wireless catalog to take the place of catalog of this company and above all that you can absolutely depend on our goods. There is no need for any other catalog when you have this big catalog.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $23.50.

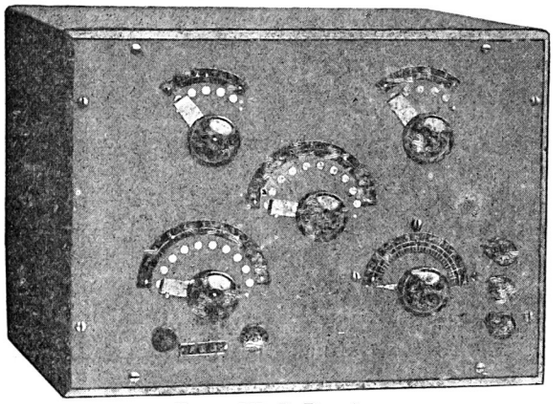


OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into two sections with one dead end switch, eliminating dead end effect and harmonic and giving greater selectivity. The end support similar to that on our Navy type permitting of looser coupling. It is a beautifully finished instrument and will be sold by us at the same price as the old model, $9.00.

THE WILLIAM B. DUCK CO., 240-242 Superior St., Toledo, Ohio

UNIVERSAL RADIO APPARATUS



Type UL-5 Receiver

It is the policy of this company never to consider a sale completed until the customer is thoroughly satisfied. Incidentally our instruments seldom fail to satisfy, because they are scientifically designed and built on honor. If you are interested in radio apparatus of the highest grade at fair prices, enclose a 2-cent stamp for our catalogue.

Type UL-5 Receiver.

This is a complete receiver for undamped waves up to 17,000 meters. No external coils, couplers or condensers are needed, since it is entirely self-contained. Sizes 8" x 12" x 7" approximately.

We control the patent rights for the Mignon System and can supply these instruments.

UNIVERSAL RADIO MANUFACTURING CORP.

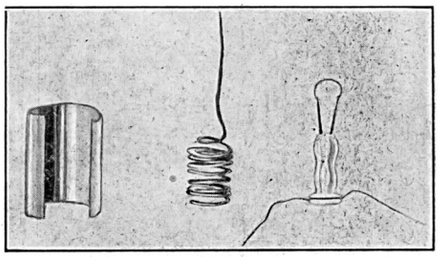
Dept. W Elmira, N. Y.

Development of Audion Bulbs

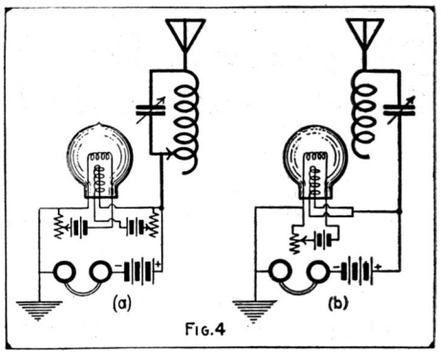
By E. T. JONES

(*Continued from page 219.*)

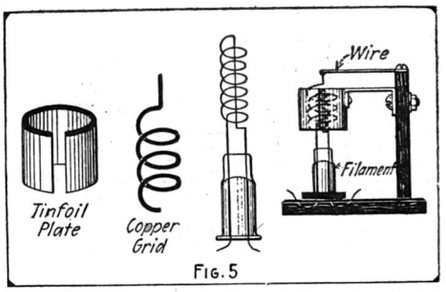
both heated, or whether one heated and the other cold the signal strength on this crude arrangement did not vary in the least; *rectification of the incoming signals*



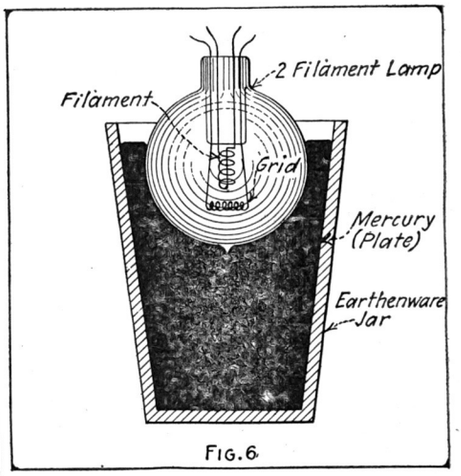
Here We Have the Elements Used in the (Open Air) Audion.



Using a Two-Filament Lamp as an Audion.



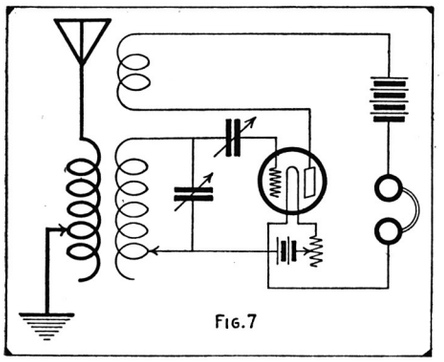
Showing the Construction of the (Open Air) Audion.



Here a Two-Filament Bulb Was Partly Immersed in Mercury, Using the Latter as a Plate.

could not be the direct cause of signals being recorded in the headphones. However, it not being the intention of the author to enter into any discussion as to the basic

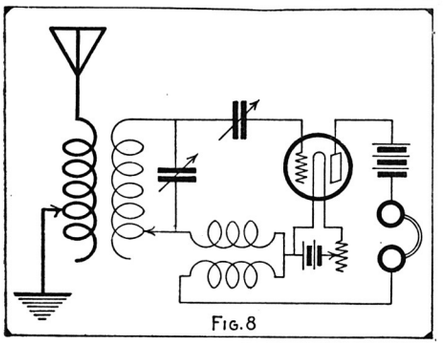
principles of the audion, these points of general interest are given for the benefit of those desirous of following up the work



Using the Tickler Circuit With the Home-Made Audion.

performed by Dr. DeForest with the embryo audion.

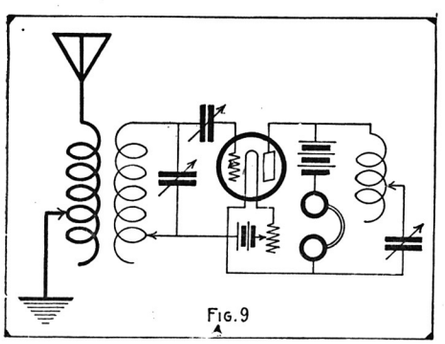
Having at hand quite a number of filaments in their respective supports, we constructed an (open-air) three-element audion shown in the photograph. The plate was made of tinfoil, the grid of copper wire well polished, and these two elements were supported by a wooden post as shown and brought directly over the filament. This constituted our first three-element valve. Due to the fact that the filament was not sealed in a vacuum chamber, we could not burn it as brightly as we desired and for that reason very poor results were had, and it was found necessary to employ



This Shows the Circuit Wherein a Variometer Is Used to Couple the Plate and Grid Circuits.

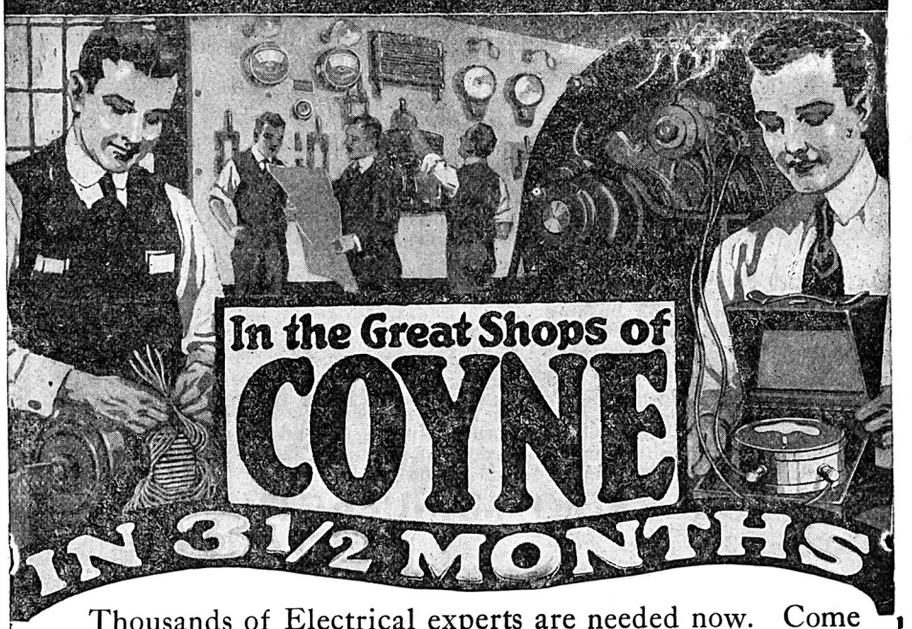
as high as 180 volts on the plate circuit. The local Naval Station NAH was heard with an audibility of approximately 20, and this type of audion also demonstrated the necessity of a certain distance between the elements in respect to the sizes thereof.

Finally, we turned to the *two filament lamp* and finding that tinfoil placed on the top of the bulb did not furnish what might be considered an efficient type of plate, we immediately struck the idea of placing the lamp upside down in an earthenware container of mercury, and this proved the best of any arrangement we experimented with. The cross section of the tube in the vial



A Variable Condenser and Inductance Used to Tune the Plate Circuit.

Learn Electricity



In the Great Shops of COYNE IN 3½ MONTHS

Thousands of Electrical experts are needed now. Come to the great shops of Coyne and let us train you quickly by our sure practical way backed by 20 years of success.

Earn $125 to $300 a Month

Come to Coyne where experts train you on the actual apparatus. You work on everything from the simple bell to the mighty Generators, Electrical Locomotives and Power Plants. Everything to make you a Master Electrician. Look at the picture taken from life in our shops.

Become an Expert in 3½ Months

No need of taking 1 to 4 years to become an expert. We have proved this in thousands of cases. We are the only school teaching by the original Coyne methods, which means no books, no classes—all practical training.

Earn Your Way. Our employment department will help every ambitious man to earn a part or all his expenses—without charge.

LEARN DRAFTING

The country needs hundreds of skilled Draftsmen in all lines at big salaries.

Coyne is the only school in the country that gives you the advantages of big shops full of construction and machinery. This makes our drafting courses practical, just like the job you'll have when you graduate. You can't get this in any other school.

WE TEACH ELECTRICITY, DRAFTING, MOTION PICTURE OPERATING AND PLUMBING

We teach all these professions in such a thorough, practical way that when you finish you can step right into a position of responsibility and big pay. Fill out the coupon *now* and send it for our big free book of information. It tells what others are doing and have done, what you can do.

Be sure and check the trade that interests you. Do it now

Bennett W. Cooke, President
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 11-X, 39-51 E. Illinois Street
CHICAGO, ILL.

COYNE SCHOOLS
Dept. 11-X, 39-51 E. Illinois St.
CHICAGO, ILL.

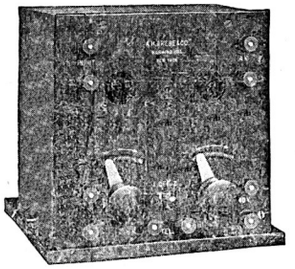
Please send me that big free book. I'm interested in:
[ ] Electricity [ ] Drafting
[ ] Plumbing
[ ] Motion Picture Operating

Name .....

Address .....

Read All Signals That Reach Your Station

With the ordinary receiver many signals never become audible. Those stations you've wanted to hear can now be brought in with surprising intensity if you connect into circuit a



GREBE RADIO

Two-Stage Audio-Frequency Amplifier

This amplifier is designed to eliminate howling due to resonant feed-backs, without impairing its amplifying efficiency. The cover is hinged, affording accessibility to all parts. The sockets accommodate the standard four-prong tube and perfect contact is secured through strong phosphor-bronze springs.

The wiring and mechanical construction are characteristic of Grebe workmanship. Better be sure your Amplifier is a Grebe.

Type RORB, Price $45

Write for free bulletin describing Grebe Amplifiers; complete catalog sent upon receipt of 10 cents.

A. H. GREBE & CO., 72 Van Wyck Blvd., Richmond Hill, N. Y.

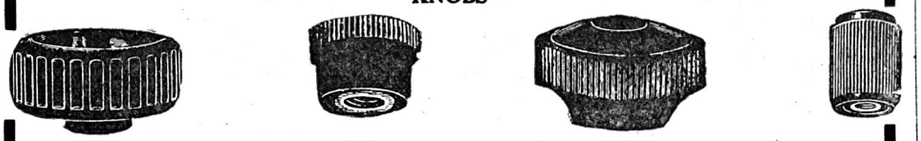
SPECIAL

Switch points listed below complete with brass screw or ¼" brass nut for month of November only. Immediate shipment. Large stock.

SWITCH POINTS	Doz.	50	100
No. 626—¼" dia. x ⅜" high tapped 6-32	$.30	$1.00	$1.75
No. 627—¼" dia. x ¼" head ½" shank 6-32	.36	1.25	2.00
No. 628—¼" dia. x ¼" high tapped 6-32	.30	.90	1.50

Above plain brass finish—Nickel 50 per cent. advance.

KNOBS



602 608 606 601

	Each	Doz.
No. 601—½" dia. 8-32 bushing	$.05	$.50
No. 602—1" dia. 8-32 bushing	.10	1.00
No. 606—1¼" dia. 13/16" high	.20	2.00
No. 608—11/16" dia. 15/32" high, 10-32 bush.	.06	.60

SEND TODAY FOR YOUR COPY OF OUR NEW CIRCULAR G SHOWING COMPLETE LINE.

Agents for all the reliable manufacturers. Send us your orders and inquiries. Prompt shipment of Murdock, DeForest, Clapp-Eastham, Brandes, Bunnell, Grebe, Thordarson and AudioTron apparatus.

SHOTTON RADIO MANUFACTURING CO.

P. O. Box 3 SCRANTON, PENNA.

Branch—8 Kingsbury St., JAMESTOWN, N. Y.

RADIO INTELLIGENCE BUREAU

Are You Prepared to Pass the Government Examinations?

Earn $125 to $150 per Month

Complete Course and Practice Buzzer Set

for $15.00

Study at home during your spare time. We place into your hands a complete course prepared by a leading authority on the subject with practice set complete for fifteen dollars and express prepaid. All questions answered free after purchase of course. The entire faculty is at your command to solve your problems.

We maintain a Query Department and all questions will be answered at the rate of 25c each. If questions involve considerable research work, etc., a special charge is made. This charge shall never exceed five dollars.

WE DESIGN

Wireless Receiving sets; Wireless Transmitting sets; Wireless Telephone sets; Underground "Rogers" installations, complete or individual instruments, at nominal cost. Build your own apparatus at one-tenth the cost. We furnish dimensions, drawings, and diagrams complete. Get in touch with us at once—you will profit by doing so.

RADIO INTELLIGENCE BUREAU, 86 Roosevelt Pl., New Orleans, La.

CHRISTMAS IS COMING

Make your gifts this year things your friends will appreciate.
Christmas Outfits (Electric Light Outfits, lamp figures, flowers, etc.) Electrical Toys. 15 Cells B-Batteries, 22.5 volt, 98c postpaid. Radio apparatus and parts. Ammeters and Voltmeters. Electric Irons, $4.75 and up. Electric Table Stoves, Toasters and Cookers, $3 and up. Electric Dish Washer and Clothes Washing Machines. Electric Steam Engines, Aeroplanes and Trains. Electric Radiator and Reflector Heaters. Electrical Supplies, Flashlights (and accessories) all sizes. Mazda Lamps from 1½ volts to 240 volts. "MAKE-UR-OWN BATTERIES" $1.25 and up. Powerful hand search lights, $1 and up. Storage and Dry Batteries. Toy and Bell Transformers, $1.65, 1.90 and up. Vacuum cleaners with all attachments. Send stamp for complete bulletin of our entire line.

The H. S. WIRELESS CO.
164 Ross Street, Brooklyn, N. Y.

NEW ORLEANS
WIRELESS SUPPLIES AND MINERALS OF ALL DESCRIPTIONS
L. A. ROSE
4323 MAGNOLIA STREET
NEW ORLEANS, LA.
SEND 6 CENTS FOR CATALOGUE

AMATEURS
RECEIVING OUTFITS AND INSTRUMENTS
Complete Tuning Coil Receiving Set $4.00
Send stamp for descriptive literature
MAYMIN RADIO MFG. CO.
1845 E. Twelfth Street, Brooklyn, N. Y.

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 262-263.

of mercury is shown in Figure 6. The bulb was held in the vial of mercury with a piece of No. 18 bell wire first wrapt around the neck of the bulb and then around the vial, considerable pressure being demonstrated by the volume of mercury being displaced by the (light) lamp vessel.

With this type of audion signals were received from the local station practically as loud as when employing a galena detector. However, due to the fact that the filament employed as the GRID is placed in such a manner as to be only in between the filament and that portion of the plate which is at the very top of the lamp, it was found that the lamp could be practically removed from the mercury and signals did not decrease in the least. This demonstrated that with a tube of this type all that is necessary is a plate covering its top portion. A considerable amount of voltage was employed on this crude audion tube; however, signals can be received with about half the sensitivity of a good crystal detector with approximately 40 volts. If it is desired to get maximum results 150 volts is necessary.

From the foregoing results, it having been found that it was only necessary to cover the very top of the lamp with foil for the plate, an audion was constructed as shown in the photograph and with this bulb very good results were had. Several of the circuits employed are given in Figures 7, 8, and 9, for the benefit of those not already familiar with the usual run of circuits best suited for overall efficient handling of vacuum tubes in their respective circuits.

Further experiments are being conducted with these types of tubes and it is hoped that ultimately we will derive an audion which will work as well as the present-day commercial type.

Practical Suggestions on Audion Circuits

By S. C. HENRY

(*Continued from page 229.*)

be of flexible armored lighting cable or ordinary cord covered with metal foil and taped. If the light is very close to the receiver, it may be necessary to cover it with screening, also grounded. Much supposed trouble from induced hum, blamed on high tension lines, would be minimized if the filament lighting battery be grounded and wires adjacent to the operating room metal covered, with the covering earthed; because of the fact that by capacitive induction such noises are often transferred to electric lines of lower voltago and from them to the receiving set. One may readily ascertain by disconnecting his aerial whether the trouble comes from induction to the aerial or to the receiver itself.

With regenerative circuits with amplifiers, a direct connection must replace sliding or slipping contacts on variable condensers. "Pigtails" made of "Belden braid" or thin sheet metal, or even stranded wire soldered to the shaft of the moving plates and formed into a flat spiral will serve. Cotton sleeving such as used by armature winders slipped over the pigtails and having its ends bound with thread will prevent the turns rubbing together. Stops must be placed on the condensers to prevent them being turned more than one revolution. The slipping contact connection must be removed or the trouble will still exist. Similar pigtails should be provided on all the multi-point switches used for varying inductions if the operator wishes to eliminate the ear-splitting noises

which will result if the receiver be given a slight jar.

If you wish to gear the condensers to a fine adjustment knob, do not place metallic gears in mesh with one another. Use fibre or bakelite. Similarly, if a rack and pinion device be used for varying coupling, make either the rack or pinion of an insulating material.

Bear in mind that the plate voltage for tubes using the new standard bases is not critical so that potentiometers and multipoint plate battery switches can be dispensed with and noisy contacts eliminated. There is only one way to connect plate ("B") batteries together ,and that is with well-soldered joints.

Allow for looser coupling than on an ordinary receiver if you wish to take advantage of the selectivity obtainable especially when continuous wave transmitters, including radiophones, are being received.

Below are a few practical examples of what may happen when signals from an oscillating audion are amplified. Distant arc signal harmonics on about six hundred meters have been received without an antenna with the receiver in a room covered on all sides with fine mesh screening, with the screening grounded. With a similar set induced clicks from a telegraph set ten feet from the room were highly annoying to the operator's ears. In the same instance, telephone conversations induced from a line one hundred feet away could be easily understood. The Navy found it necessary at one of its long distance receiving stations to cover its receiving booths on all sides with sheet copper, grounding the copper and covering an electric light placed on the ceiling with screening. Induction from the ignition circuits on submarine chasers was eliminated by means of series choking coils and large value condensers grounding the circuits.

The experimenter should not become disheartened by the above information because if trouble is experienced, either grounding both sides of the offending lines through one of the microfarad telephone condensers or shielding the receiver, or shielding the lines and apparatus causing the interference, or the use of all the means, if necessary, will cut down "induction" to a minimum. The use of radio frequency amplification may also help.

Those who wish reliability and ease of operation should not employ tuned plate circuits, although there are times when freak adjustments can be found to bring in unusually loud signals.

The Third Pill

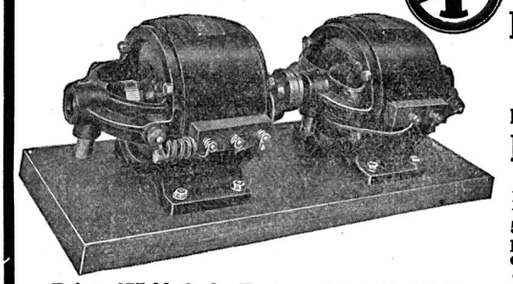
By J. K. Henney

(*Continued from page 237.*)

"Here," I thought, "there is no use going crazy over a little hallucination like this. And I for one won't go mad."

Emphasizing this last statement, I brought my hand down on the table with considerable force. But, strange to say, the table did not resound with a smack. There was no mixup of papers as I had expected. Instead the hand went straight through the table and hit, not my knee, which was directly underneath, but my pig-nosed generator. I looked down and instantly brought my hand back in amazement and fear. The generator had come to life, its pig nose was gazing at me with

A MARK OF QUALITY



Price, $75.00 f.o.b. Factory—Weight, 80 lbs.

INTERNATIONAL RADIO

High Voltage—Direct Current

Motor Generators

This unit has a normal output of 100 watts (200 milliamperes at 500 volts) with a voltage range of 200 to 500 volts. The generator is compounded to insure constant voltage under variable load. It is furnished to operate on either D.C. or A.C.; a shunt motor being supplied for D.C. and an induction motor for A.C. The generator is equipped with a commutator of 48 segments, reducing the commutator hum to a minimum.

Unit is complete with insulating coupling and mounted as illustrated on a finished base 8" x 20". Shipment can be made immediately.

The motor generator illustrated above is only one of the many newly designed radio specialties which we have ready for you. Write us for descriptive bulletins which are being issued covering all International Radio products. Address Department 22.

International Radio Telegraph Company

326 BROADWAY NEW YORK CITY

A MARK OF QUALITY

20000 METER LONG WAVE TUNER. TYPE BS.

Diagram on bottom. Involute coils machine wound beat the honeycomb. No tickler coil. XDA comes in on tap No. 1, NSS on tap No. 4. Five taps. Any aerial, loop or over head. No foreign stations guaranteed without a two step amplifier. No capacity effects. Weighs two pounds. Carry it with you. No complicated tuning—throw the switch day or night and the Arcs are going. Formica top, full nickel finish. Coils waxed in and you can work thru the worst static without interruption. Size 41/2x41/2x21/2 in. Absolutely guaranteed to bring in the sigs or we will give you back the money. Nothing like these tuners in the world. Price $15.00 delivered to you.

200 METER REGENERATIVE TUNER. TYPE CS.

Designed to amplify sigs from 175 to 300M. Fine for relay work. Used by old 9XE in all relays. Has primary, secondary fixed and tickler coil set at an angle. Ten taps on each coil. Same weight and size as cut BS. These three tuners may be set in a panel and get all the waves in use. Very selective, with the tickler coil you can tune out a 1KW set within one mile with only one tap. Price $15.00 delivered to you.

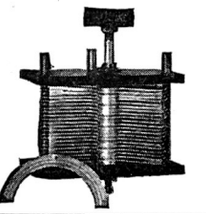
3000 METER ARLINGTON TUNER. TYPE AS.

Arlington tuner gets all from 600M. to 3000M. Ten taps primary and tickler. All coils set in wax and will work thru static when others stop. Same size and weight as above types. Price $15.00 delivered to you.

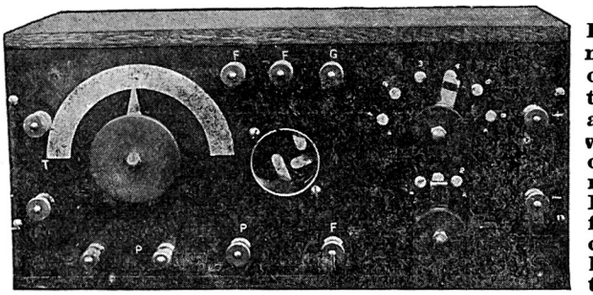
KNOCK DOWN VARIABLE CONDENSERS.

11 plate grid variable capac. .00025MF.—$1.75
21 " Sec. " " .0005 MF.—$2.25
43 " Pri. " " .001 MF.—$2.50

Packed in a neat box with full directions for assembling. Designed for panel sets and are complete with knob, pointer, graduated 180 deg. scale and means for fastening to your panel. 4000 sold and no complaints. Assemble and save money. Plates aluminum .015 thick. Designed to use with our tuners.



TRESCO Davenport, Iowa.



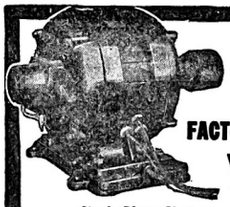
This Audion Control Panel designed and made by Arnold, is the only one of its kind on the market at present and represents the best value of any. Just think of getting an Oak cabinet with polished ¼" Hard Rubber panel front, equipped so you can use a V. T. Moorhead, or any type of tubular bulb, with switch so that you can use either at will? A six point switch for battery control giving 16 to 40 volts? Yes Batteries are included, best make, and a mica grid condenser.

A concealed rheostat with only knob, pointer and scale showing. All connections made with stranded wire, and soldered. Special posts for phone plugs, binding post connections nicely lettered on rubber and filled with white. Size over all 12" by 6" by 6". Price as shown $19.50.

Call and try one out.

J. F. ARNOLD

Established 1910. 2082 LEXINGTON AVENUE, NEW YORK



NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$24.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$46.50
1	H. P., 110-220 volts, repulsion, with sliding base	$67.50
2	H. P., 110-220 volts, repulsion, sliding base	$108.50
3	H. P., 110-220 volts, repulsion, sliding base	$124.50
5	H. P., 110-220 volts, repulsion, sliding base	$164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

6 volts, 10 amp.	$16.50
15 volts, 10 amp.	$21.00
40 volts, 6 amp.	$24.50
110 v, 2½ amp.	$24.50
40 volts, 12 amp.	$38.50
110 volts, 5 amp.	$38.50
40 volts, 25 amp.	$58.50
110 volts, 10 amp.	$58.50
Moving Picture Arc Generator	$85.00

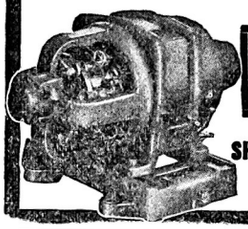
Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 RPM., complete with base and pulley.

½ H. P.	$42.50
1 H. P.	$59.50
2 H. P.	$72.50
3 H. P.	$84.50
5 H. P.	$102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

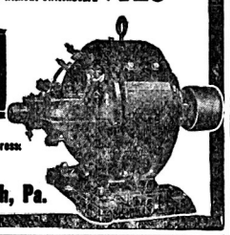
110 volts, A. C., 100 watt, 24 volts, without switchboard	$40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard	$68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard	$75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard	$85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard	$85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard	$110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard	$125.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



1/4 H.P. SPECIAL 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. **$19.75 EACH** Reg. Value $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 16, West End, Pittsburgh, Pa.

WIRELESS
AMATEURS, DEALERS AND MANUFACTURERS!

Have You Seen The
"DEPENDABLE"
Line of Radio Instruments and Complete Sets?

We manufacture a large line of **DEPENDABLE** apparatus—not the cheap mail order variety, yet our prices are low. Tuners, Couplers, Detectors, Fixed and Variable Condensers, Loading Coils, etc.; also Binding Posts, Switch Points, Switch Levers, etc., etc.

Send for New Catalog No. 9 to our New York office,

19 Park Place, New York City.
DORON BROS. ELECTRICAL CO. - - - HAMILTON, OHIO.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 26th St., Valparaiso, Indiana

CONTACT POINTS DEALERS and MANUFACTURERS should get our prices in all quantities before ordering your Fall Supply.
Several styles—ANY QUANTITY—GOOD DELIVERY. Samples and price list 2 cents.
A. H. CORWIN & CO. NEWARK, N. J.

Everything You Want to Know about A.C. Motors

IS FOUND INSTANTLY IN THE

Electrical Worker's Friend

The only complete book of its kind for the man on the job or the student. Will make you an expert motor repairman. Contains 66 electric motor drawings with complete instructions for rewinding and reconnecting. Tells how to put each coil in the slots, how to get speed, alternations, cycles, poles, how to find the coil throw, number of coils per group and number of groups, etc.

Covers all practical reconnecting changes from one phase to another, from one voltage to another, or changing both the phase and voltage at the same time.

Written so you will understand it. You need this book—send for a copy to-day.

$3.50 or we will Ship C. O. D. if You Prefer

Free Circular on Request

HENRY F. BOSSHART
P. O. Box 68, Homewood Sta., Pittsburg, Pa.

RECO QUALITY

SUPERLATIVE RADIO EQUIPMENT
THE BEST KEY IN THE COUNTRY
10 Amp. $7.75—20 Amp. $8.25
A three cent stamp will bring bulletins of this and other higher grade apparatus.
THE RADIO ENGINEERING COMPANY,
22 St. Paul St. Baltimore, Md.

American Electromotive Co.
Creators of Advanced Apparatus
Enclose Stamp for Catalog
319 East 68th Street, New York

SEND TO-DAY
For Catalog for Complete Line of
Receiving Apparatus
REMLER RADIO MFG. CO.
163 Sutter St. San Francisco, Calif.

the utmost hatred in its expression. I thought of the many times I had mistreated that electrical machine, of the many times I had blown out its fuses, and of the usual habit of sticking my feet on it. My eyes hardly grasped the strangeness of the phenomenon. I saw that my two red pills had become the eyes of the beast on the floor, but what had become of the lizard was not apparent at once.

I do not know how long I sat there and watched those red eyes, fascinated by something in their depths. Then I saw the lizard. He was on the switchboard, bringing two wires from the mercury lamp behind. I knew at once what those wires were for. *He was going to electrocute me*, one wire on top my head, the other round my neck. Yet I did not move. I sat there with a sort of glassy stare, a feeling of utter dread filling my body, but with an inability to move that frightened me. Slowly the wires came toward me until one finally came in contact with my hand. It burned and shocked me unbearably. I tried to pull my hand away, but the movement was utterly impossible for my nerveless fingers. The other wire came closer and closer. The red eyes of the pig animal stared at me, the lizard waltzed across the room in a terrifying oscillation, and I uttered a cry of terror. With a superhuman effort I opened the switch that controlled the current, thereby plunging the room into darkness, but at the same time protecting myself from those wires.

"Now," I thought, "I'm saved."

But I had jumped at conclusions. The generator animal was now busy. He was lolling across the floor with an uncertain gait, going toward the skylight where the walking-beam was still pounding away. The animal tore away the partition separating me from the engine room, and at once I saw what he was going to do. The piston rod was disconnected, brought closer and closer to the radio room, until it was only a foot from my head. Yet it kept up its incessant pumping motion, and the rhythym seemed to say:

"ThE tHiRd PiLl WiLl KiLl A mAn."

The piston at last reached my head. It pounded and pounded, each time striking me down, down, down, until I felt myself going through the floor. That sinking sensation was terrible, and I shall remember to my dying day that pound, pound, pound. I fell farther and farther, and finally was about to hit the bottom of the ship, a shapeless mass of flesh, devoid of all life, when I brought up with a smash.

I was dead, quite dead.

As soon as I had determined that I was *really* dead, and that I had lost the sense of feeling, things began to take on visible shape in my mind. As soon as I was able to open my eyes, instead of floating downward thru space and on blanketed air, I saw that I was back in the radio room, flat on my back on the floor. My head was behind the pig-nosed generator and my feet under the switchboard touching two wires. I was being gently jolted by a current of electricity that leaked thru the soles of my shoes. One hand occasionally touched the wires on the generator, making a more complete circuit and giving me a harder shock.

There was a pounding at the door, which explained the pounding on my head, while behind me the piston rod was keeping up its incessant thump, thump. My headache was entirely gone, but in its place was a terrible nausea. I crawled to the door and admitted the steward. He helped me into my chair at the same time joking about my fainting.

"You had better take one of my pills," he said.

In no uncertain terms I informed him that I had already taken all three of them several times, and that I wanted no more.

"Why, no, old man," he replied, "here are two of the pills on the table," and then I saw his eyes change their expression. Instead of a jocular light there was a look of troubled concern, finally changing to fear.

3-Inch Dial Indicator

3-in. dial, only **75 cents**, postpaid.

3-inch dial, with government type Bakelite knob, **$1.30**, postpaid.

Bulletin No. 1, describing these parts, has been sent to all who sent for our July 1st catalog. If you have not received our catalog, send five cents in stamps for it and get on our mailing list for future bulletins free.

RADIO MEN

Make Your Apparatus Up To Date

Indicating Dials at reasonable prices are now available.

These Dials are fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white.

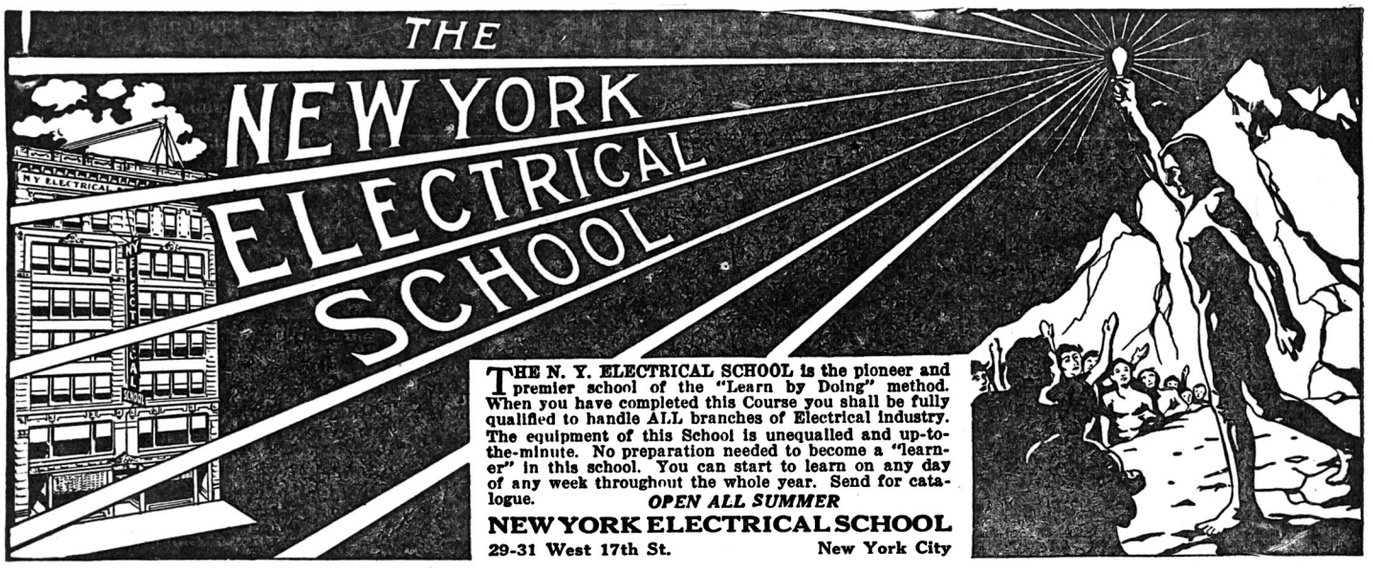
Diameter of Dial is 3 inches, and they are 3/16 in. thick. The edge is bevelled. The hole in the center will pass 8/32 screw, and there are three holes around the center hole to fasten on knob. (These holes are not shown in illustration.) We can furnish Dial alone or with fine Bakelite knob mounted. This knob has a set screw to the shaft of instrument to which dial is to be applied—heavy knurling.

If your dealer cannot supply you, send us his name with your order. Immediate deliveries.

For sale at all Radisco Agencies

A. H. CORWIN & CO.

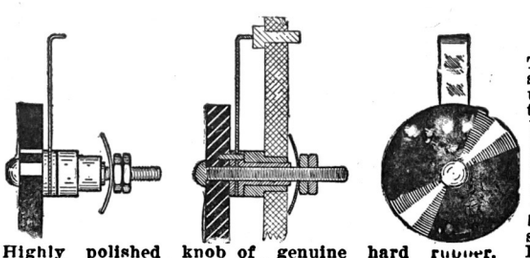
4 West Park Street :: NEWARK, N. J.



THE N. Y. ELECTRICAL SCHOOL is the pioneer and premier school of the "Learn by Doing" method. When you have completed this Course you shall be fully qualified to handle ALL branches of Electrical industry. The equipment of this School is unequalled and up-to-the-minute. No preparation needed to become a "learner" in this school. You can start to learn on any day of any week throughout the whole year. Send for catalogue. *OPEN ALL SUMMER*

NEW YORK ELECTRICAL SCHOOL

29-31 West 17th St. New York City



Highly polished knob of genuine hard rubber. Edgewise contact switch lever pinned to knob. Large brass bearings and shaft. Adjustable tension.

WILCOX PANEL SWITCH

"The Best"

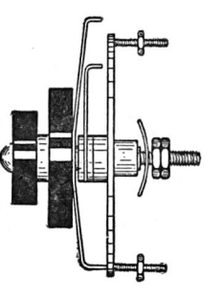
TYPE A, a beautiful and efficient standardized switch for general use is furnished in two sizes and two finishes.

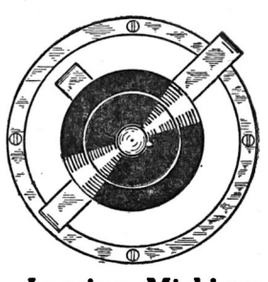
1½" Radius, pol. brass fin.	50c
1½" Radius, nick. plated fin.	60c
1 " Radius, pol. brass fin.	40c
1 " Radius, nick. plated fin.	50c

TYPE B, is a compound switch specially suitable for primary of loose couplers. One size 1½" outside radius.

Polished brass finish	$1.10
Nickle plated finish	$1.25

ALL POSTPAID

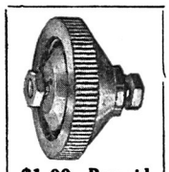




THE WILCOX LABORATORIES - Dept. G - - - Lansing, Michigan

WIRELESS TELEPHONE TRANSMITTERS

need not be expensive



$1.00 Prepaid

MAKE YOURS!

The Skinderviken Transmitter Button (thousands of which are being used on telephones all over the world) is the most sensitive current operator for sound waves. For use in radio telephony, we have developed a special model, possessing such excellent features as:

No packing of carbon granules. Angular position of diaphragm, no consideration. Maximum volume for minimum current. Buttons arranged in multiple for large current. Dead resistance and side tone practically eliminated. Clear, sharp articulation. Freedom of button to expand. Unusually large heat radiating surface.

THIS Transmitter Button has an unlimited field for experimenters in all branches of telephony—detectiphones—phonograph music transmis- etc.

Local Battery, 2 to 7 volt $1.00
Radio, 30 to 45 volt $1.00

BOOKLET FREE

J. SKINDERVIKEN, Dept. R.N.
Inveator and sole distributor
335 Broadway, NEW YORK, N. Y.
154 W. Randolph St., CHICAGO, ILL.

Publishes cash art assignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students. Satisfactory or money refunded. 20c a copy, $1 for 6 issues. *Send $1 NOW, Thrift Stamps Taken.*
G. H. LOCKWOOD, Editor, Dept. 540, Kalamazoo, Mich.

ACROMATIC TELESCOPE

Made upon new scientific principles, nicely brass bound with powerful lenses, scientifically ground. Travelers, hunters, farmers, boy scouts and everyone needs a telescope. Have you ever enjoyed the marvels of a telescope? Each telescope guaranteed just as represented, or money promptly refunded. Send 99 cents to-day.
EASTERN NOVELTY CO., Dep't 177 E, 93 St., New York

Swing 4 in., 11 in. between centers, 17 in. total length. Shipping weight 13 lbs. Bed of lathe is machined. Workmanship first-class. Equipped with wood turning chuck. Can be fitted with 3 in. face plate and drill chuck as special equipment. Order one today. Price $5.00 cash with order. SYRUPP BED CO., DEPT. F, TOLEDO, OHIO

Be FREE from STAMMERING

HOME COURSE. Physical Culture methods strengthen the voice organs. Simple exercises form the habit of easy, correct speech. Results GUARANTEED or NO PAY. Write for full particulars. *IT CAN BE DONE AT HOME.*
Sutherland School, Educational Bldg., 70 5th Av., New York

Switch Contacts—No. 5000 Nickel Plated
brass contacts approximately ¼" x ⅛" head with No. 6 x ¾ machine screw shank and one N. P. nut.
Thirty-five cents per dozen.
Send postal for catalogue or five cents for sample contact

Toledo Radio Specialties Co.
Box 343 C. P. O. Toledo, Ohio

"Where did you get those things?" he asked, pointing to the box.

"Out of your blooming medicine chest," was my rather chesty reply.

"Then I must have made a mistake. I guess it's a good thing you didn't take more than one. You see, old man, that one pill was enough to set a dozen men dreaming the way you have been doing."

Slowly the steward crushed the two white pellets under his shoe. His face was regaining its color, and he turned to me with a shrug of his shoulders as he said:

"Those pills were pure opium."

Your Fist

By C. H. PFEIFFER

(*Continued from page 232.*)

so deeply engrossed in applying their swing that they forgot what they were talking about and had to stop to collect their thoughts!

The happy medium is obvious. Probably the best way to attain it is to strive to imitate the perfect machine sending; then, since we are not machines, the human element will take care of itself.

It is too bad that the amateurs of the country have so few examples of good sending to take pattern from. The Glace Bay and Clifden stations, when operating on a full busy schedule, give an exhibition which it is a pleasure to listen to. In addition the writer has in mind the Wanamaker stations in New York and Philadelphia previous to the war. Such work should be an incentive to the amateur.

Some of the busier Mexican operators could give us lessons in speed sending. They ramble along at an average of thirty words per minute with few breaks, and outside of a certain negligible carelessness and tendency to run words together they should be entertaining to the student of fistology, that is if one could get near enough to hear them through the static.

Now that handwriting has proven to exhibit one's character, who will be the pioneer to establish character readings from the sending style? Who will deny the possibilities?

Increasing the Secondary Voltage of Your Transformer

By F. E. TERMAN

(*Continued from page 231.*)

would result. The primary insulation should be replaced, and the two taps just made, then the leads from the outside of the primary coil are brought to a three point switch to regulate the power.

Some transformers will stand a considerable overload for short intervals, without appreciable heating, and for the amateur who is desirous of making extreme long distance records, advantage may be taken of this fact, if one does not abuse it. If a tap is taken from the center of the primary winding, an overload of about 50% will be obtained where a transformer such as the old style one-half kilowatt, 7,000 volt instrument is used, and even after an hour's continuous conversation the secondary will be only a trifle warm to the touch, while the heating of the primary is negligible. A word of caution should go with this, however, since one must be careful not to use the high power continually, or to short circuit the secondary of the transformer, or let

ATLANTIC RADIO CO.

Our line of new apparatus comprises the latest post-war equipment.

Prepare your station for the new era in the amateur radio world by equipping with our standard, high grade apparatus, parts and supplies.

34 Batterymarch Street BOSTON MASS.

VACUUM TUBE CONTROL PANEL

Most efficient and neatest panel manufactured.

Bakelite panel, graduated dials, mounted in oak cabinet. Variable grid condenser, rheostat, and tube receptacle mounted back of panel.

May be used in any circuit.

PRICE-less Bulb (with V.T. Base or Audiotron mounting)—$15.00
For Full information write

DAYNOR RADIO ELECTRIC COMPANY
Box 105 Wilkinsburg, Pa.

CENTRAL RADIO ENGINEERING CO.
604 W. 60th Street,
Chicago, Ill.

LIMITED OFFER
3500 METER
Loose Coupler $8.50

Highly finished in golden oak or mahogany
Slider adjustment on Primary and Ten Tap Switch on Secondary.

22" Long 7" Wide 7½" High

Send 2c Stamp for our Bulletin A.

AMPLIFIER UNITS

TWO STEP $15
Consisting of two amplifier coils, five condensers, three grid leaks, mahogany case and nine terminals.

ONE STEP UNIT $13
AMPLIFIER COIL $6
Send for Descriptive Circular

RADIO SALES CO.
1629 McALLISTER ST., SAN FRANCISCO, CAL.

MEMORIZE CONTINENTAL CODE ALMOST INSTANTLY

My method is the short cut. Complete chart and full instructions, 10 cents.

C. K. DODGE
Mamaroneck, N. Y.

an arc form across it, as this would lead to the possibility of a burned-out secondary. When such power is first used, it is wise to carefully watch the transformer for any heating that may arise, and if a rapid rise in temperature occurs, it is best to discontinue the use of the very high power.

Now a word as to the results obtained with such a system. The writer owned a transformer, similar to the one mentioned, which drew 220 watts without taps, and 350, 500 and 800 watts on the three taps taken, the latter giving an overload of 60%, and altho with such an overload the transformer could not have as high an efficiency as on the 220 watts, still the results obtained were gratifying, to say the least. Tests were made in actual transmission, before amateur stations were closed, on all powers, with one amateur 320 miles away, and another 650 miles distant, and they both agreed that the 800 watts was twice as loud as the 220 watts, while the 500 watts was almost, but not quite as loud as the 800 watts.

For owners of transformers such as the type mentioned, this affords an easy method of increasing the range without expense, and the expenditure of about thirty minutes' time, and if carefully done, no damage can possibly result to the transformer. This should never be tried with high voltage transformers, since these transformers already have the necessary secondary voltage, or with transformers that have given trouble with heating or insulation, but with a well-built low secondary potential transformer success is certain to follow the attempt.

How Manufacturers Work "Formica" and "Bakelite"

J. STANLEY BROWN

(*Continued from page 228.*)

may be taken off with fine sandpaper and oil. The panel is then heated in boiling water and the numbers are stamped on.

It might be stated here that with the same tool and by use of the same methods either "Bakelite", celluloid or metal dials may be calibrated. Metal dials are given a satin-nickel finish and the depressions are filled in with red lead.

If the preceding instructions are followed out the working of insulating material such as "Bakelite" or "Formica" should be a pleasure instead of a form of drudgery.

I Want to Know

(*Continued from page 244.*)

A. 1. You should be able to cover several hundred miles.

A. 2. By connecting it across the receiving circuit proper, as shown in the diagram, which is in answer to your third query.

A. 3. Circuit is given herewith.

DENMARK PLANNING WIRELESS TO THE UNITED STATES

A dispatch from Copenhagen to the Danish Legation says that the Danish Minister for Public Works has announced in the Upper House that his department was working out plans for "a great trans-Atlantic wireless station near Copenhagen, which will put Denmark in direct wireless communication with the United States.

Install a U. S. Army Hot-Wire Ammeter In Your Station

Imagine the increase in transmitting range one of these highly efficient Roller-Smith Hot-Wire Ammeters will bring you. A sharp wave, with maximum energy on one hump under all weather conditions; rapid adjustment to various wave lengths; increase or reduction of energy to work a certain station—these are some of the advantages that can be yours.

Regularly $13—Our Special Price $7

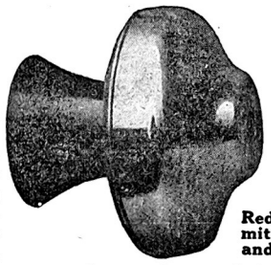
These Ammeters are of the flush type and were made for the U. S. Army Air Service for use on fighting planes. The Armistice brought a cancellation of airplane contracts and these Ammeters could not be used. Each has passed the exacting Government tests and is in perfect condition. They have not been removed from their original cartons and are now ready for immediate shipment.

The scale reading is: 0-2.5 Amperes. Shunt giving double or triple this range, 75c. extra.

Only by buying a large quantity of these Ammeters are we able to sell them at almost half the usual price. This is your opportunity to procure at an unusual bargain a standard U. S. Army Air Service Hot-Wire Ammeter. The supply is limited. Better get in on this today as there is a great demand for these instruments. Remit by check or money-order. Dealers write us, we have an attractive proposition for you.

A. H. GREBE & CO. 72 Van Wyck Blvd. RICHMOND HILL, N. Y.

SPECIAL SALE!



Reduced Photograph of Transmitter showing nickel plated case and Hard Rubber Mouthpiece

$1.00 ONLY

Postage extra.

Ship. Weight, 2 lbs.

Diameter, 3¼ ins.

We have on hand 2,000 Carbon Grain Transmitters as per photograph. They are first-class instruments and may be used for all kind of experiments, especially for wireless telephone sets, where a heavy current is to be passed through. Slightly used, but in perfect working order. Money refunded if not satisfied. A real bargain. Order one or more today.

THE ELECTRO IMPORTING CO., 231 Fulton St., NEW YORK

Wireless Taught By Mail

OPERATORS NEEDED NOW — GOOD PAY — RAPID PROMOTION

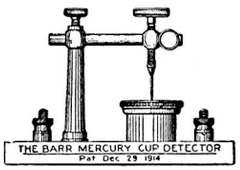
MEN and boys needed for Merchant Marine, big land wireless stations—Aerial Mail Service—Railroad and Telegraph Companies—Lake and Ocean Steamships. Salaries up to $250 a month. Opportunity for promotions to Electrician, Mechanic, Radio Engineer, Government Inspector. Chance to see the world or locate at land station in America. **COMPLETE COURSE BY MAIL IN TEN WEEKS.** Our students actually pass commercial examinations in ten weeks or less. Start studying NOW in spare time at home. We send you complete set practicing instruments for receiving and sending messages while studying course. We help you secure position in commercial or government radio service. Two concerns will take all operators we can furnish.

Write today for Free Book and particulars.

NATIONAL RADIO INSTITUTE, Dept. 143, Washington, D. C.

THE BARR

Mercury-Cup Wireless Detector



The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Co.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct.

Instantly adjustable at a constant pressure.

For full information and price—write

The Barr Mercury-Cup Detector, Dept. B. The Wyoming, Washington, D. C.

MASSACHUSETTS RADIO AND TELEGRAPH SCHOOL

RADIO AND TELEGRAPHY Day and Evening Classes

18 Boylston Street Tel. Beach 7168 Boston, Mass.

MAGAZINE Prices Slashed

Millions of magazine subscriptions expire this month! With tremendous advance of paper prices and labor it is certain that nearly all magazines will advance their subscription prices at least from 25% to 50%.

BY ORDERING NOW YOU WILL SAVE BIG MONEY.

In announcing these wonderful prices it is with the absolute knowledge that **our readers are offered the lowest prices for standard Magazines that it is possible to obtain anywhere.** Only by special arrangement with the publishers are these prices possible, but to take advantage of them, you must act quickly. **Don't delay, do it now.** This offer is so good that of necessity it must be limited in time. Just think of buying standard Magazines at reduced prices in time for Xmas Presents, and they certainly make ideal gifts being a constant reminder for a whole year of a considerate friend. Just glance over our wonderful prices, and see how **we enable one dollar to bring you two dollars' worth,** and then make up your list. When sending your order, don't forget to state **where magazines are to be sent. But be sure you do it now. To-morrow means you may forget** and lose this wonderful opportunity. All prices quoted are for subscribers in U. S. A. only, Canadian and Foreign subscriptions require additional postage.

The Publishers Will Mail the Magazine Direct From Their Own Office to You.

BIG SPECIAL TO "WIRELESS BUGS."

Radio Amateur News	$1.50	
Electrical Experimenter	2.00	
Wireless Age	2.00	
Q. S. T.	1.50	
Everyday Engineering	1.50	
Wireless World (London)	2.75	
	$11.25	Big Special to You $10.

Radio Amateur News	$1.50	
Electrical Experimenter	2.00	
Regular price	$3.50	Our Price 3.00

Radio Amateur News	$1.50	
Wireless Age	2.00	
Regular price	$3.50	Our Price 3.00

Radio Amateur News	$1.50	
Wireless World (London)	2.75	
Regular price	$4.25	Our Price 4.00

Radio Amateur News	$1.50	
Scientific American	5.00	
Everyday Engineering	1.50	
Regular price	$8.00	Our Price 7.00

Radio Amateur News	$1.50	
Boy's Life	2.00	
Regular price	$3.50	Our Price 3.00

Radio Amateur News	$1.50	
Popular Science	2.00	
Regular price	$3.50	Our Price 3.00

Radio Amateur News	$1.50	
Boy's Magazine	1.50	
Regular price	$3.00	Our Price 2.50

Radio Amateur News	$1.50	
Everybody's	2.00	
Delineator	2.00	
Regular price	$5.50	Our Price 4.25

Radio Amateur News	$1.50	
American Magazine	2.00	
Women's Home Companion	2.00	
Regular price	$5.50	Our Price 4.25

Radio Amateur News	$1.50	
Wireless Age	2.00	
Illustrated World	2.00	
Regular price	$5.50	Our Price 4.75

Radio Amateur News	$1.50	
St. Nicholas	3.00	
Regular price	$4.50	Our Price 3.75

Radio Amateur News	$1.50	
Etude (for Music Lovers)	2.00	
Regular price	$3.50	Our Price 3.00

Radio Amateur News	$1.50	
Today's Housewife	1.00	
Regular price	$2.50	Our Price 2.00

Radio Amateur News	$1.50	
Popular Science	2.00	
Electrical Experimenter	2.00	
Regular price	$5.50	Our Price 4.75

Club No.	Magazine	Retail Price Single	Special price With (Radio Amateur News)
35	Boy's Life	2.00	3.00
25	Boy's Magazine	1.50	2.50
40	Christian Herald	2.25	3.50
100	Country Life	5.00	6.25
35	Delineator	2.00	3.00
28	Designer	1.50	2.65
35	Electrical Experimenter	2.00	3.00
35	Everybody's	2.00	3.00
35	Etude (for Music Lovers)	2.00	3.00
35	Field & Stream	2.00	3.00
35	Illustrated World	2.00	3.00
80	Literary Digest	4.00	5.25
60	Metropolitan	3.00	4.25
27	Modern Priscilla	1.50	2.65

Club No.	Magazine	Retail Price Single	Special price With (Radio Amateur News)
20	McCall's Magazine	1.00	2.25
35	McClure's Magazine	2.00	3.00
70	Outing	4.00	4.75
35	Popular Science	2.00	3.00
50	St. Nicholas	3.00	3.75
60	System	3.00	4.25
15	Today's Housewife	1.00	2.00
40	Woman's Home Companion	2.00	3.25
17	Woman's Magazine	1.00	2.10
60	World's Work	4.00	4.25
50	Youth's Companion	2.50	3.75

For computing together Magazines listed separately, add Class Number before title and multiply by 5, giving our price to you in dollars and cents.

Write for Special Prices on ANY Publication not listed here

We will save you money

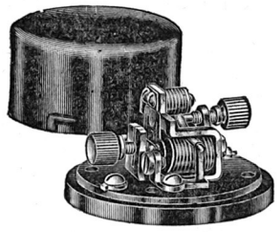
SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

EXPERIMENTER PUBLISHING CO., Inc.

233 Fulton Street, New York City, N. Y.

Mesco Radio Buzzer

With Shunt Resistance—U. S. Navy and U. S. Army Standard.



The Radio Officers of the NC planes, after testing all other buzzers, decided to use the "Mesco" on their radio equipment. The R-34 was equipped with two of them.

Why? Because of its reliability and constancy in operation; greater output efficiency; ease of adjustment; unaffected by extreme variations in weather conditions; exposed wire eliminated.

Sparking is almost entirely eliminated, so that the energy lost in light and heat in the operation of other buzzers is here conserved and radiated in the form of oscillating energy.

This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

List No. 55. Mesco Radio Buzzer. Price...$2.05

We carry a very large and complete line of standard wireless apparatus and solicit your inquiries. Wireless experts in all of our stores.

Send for the New Edition of Our Catalog M 29

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Medical Batteries, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

IT MEANS MONEY SAVED TO YOU
to have our Catalog when you want to buy.

Manhattan Electrical Supply Co., Inc.

New York: 17 Park Place | Chicago: 114 S. Wells St. | St. Louis: 1106 Pine St.
San Francisco Office: 604 Mission St.

HERE

is a sign that will make your friends shudder. Your den is incomplete without it. Fill out order in pencil and send it NOW!! Price only 20c, 3 for 50c postpaid anywhere. Sent unbent.

LEONARD BECK
1298 Carroll St., Brooklyn, N. Y.

.....

I enclose $.....cents for which send me ..... DHV signs. 7¼"/11¼". Printed in bright red on stiff cardboard.
Name .....
Address .....
City ..... State R-11

Make Your Own Wireless Apparatus

These Modern Books Tell You How

No. 5. Wireless Construction and Installation for Beginners. Explains in detail with working drawings how to make simple apparatus that works. Aerials, Tuning Coils, Couplers, Spark Coils, Keys. Sending and Receiving Sets.

No. 6. Experimental Wireless Construction. With working drawings showing how to make more elaborate apparatus, Spark Coils, Condensers, Helixes, Detectors, Loading Coils, Aerial Switches, etc. Price 30 cents each postpaid anywhere.

COLE & MORGAN, INC.
19 Park Pl., Dept. 2.
New York, N. Y.

Underwater Submarine Telegraphy

(*Continued from page 218*)

to avoid ramming boats going up and down the river. The test last five minutes.

A somewhat similar experiment was carried on at New London, Conn., in Long Island Sound, by the experimental station. Communication was established, both telephonic and telegraphic, between a hydro-airplane flying about 2000 feet in the air and a submerged submarine several fathoms under the sea.

This demonstration was given for the delegates to the Annual Convention of the Edison Society of Electrical Engineers being held at eastern points.

STATEMENT

Of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of RADIO AMATEUR NEWS, published monthly at New York, N. Y., for Oct. 1, 1919.

State of New York,
County of New York,
ss.:

Before me, aNotary Public in and for the State and county aforesaid, personally appeared Huga Gernsbeck, who having been duly sworn according to law, deposes and says that he is the editor of the RADIO AMATEUR NEWS, and that the following is to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation,) etc., of the aforesaid publication for the date shown in the baove caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Experimenter Publishing, 233 Fulton St., New York City.

Editor, Hugo Gernsback, 233 Fulton St., New York City.

Managing Editor, R. W. De Mott, 233 Fulton St., New York City.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses o fstockholders owning or holding one per cent. or more of total amount of stock):

Experiment Publishing Co., 233 Fulton St., New York City.

Hugo Gernsback, 233 Fulton St., New York City.

Sidney Gernsback, 233 Fulton St., New York City.

H. W. Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of the total amount of bonds, mortgages, or other securities are (If there are none, so state):

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him. H. GERNSBACK.

Sworn to and subscribed before me this 9th day of Oct., 1919.

BEATRICE K. OWER, 1129.

(My commission expires Mar. 30th, 1921.)

Note.—This statement must be made in duplicate and both copies delivered by the publisher to the postmaster, who shall send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the post office. The publisher must publish a copy of this statement in the second issue printed next after its filing.

DEPARTMENT OF COMMERCE
Navigation Service
Office of Radio Inspector
Customhouse
New York, N. Y.
September 30, 1919.

ARE YOU **SLIPPING?**

Are you losing your grip—your ability to DO things, to make any progress in your business or even to make good in your present position? If you wake up in the morning tired before you begin the day, with your back aching, your digestion out of order, your nerves frazzled, your brain befogged, *don't let yourself slip any further;* there's no toboggan slide so rapid as the road down to chronic ill health and the consequent loss of all enjoyment in life.

Get a Grip on Yourself

Don't wait a single day before taking steps to rid yourself of the ailments or bad habits that will be millstones about your neck as long as you live, if you don't free yourself from them. When a man is on the limited for the scrap heap every day counts; what is easy to-day will be a heap harder tomorrow, almost impossible if you wait too long.

STRONGFORT
The Perfect Man

YOU CAN DO IT

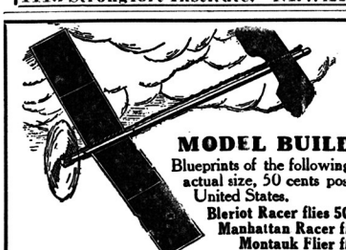
You can have renewed vitality; health, strength, energy, all that makes life worth living, if you throw away all druggist's dope and take hold of yourself in the right way.

I'LL SHOW YOU HOW

I have shown the way out to thousands of men who knew they were losing their grip on things through indigestion, constipation, biliousness, and other ailments; I have shown them how to gain the energy and strength of will to break off bad habits they knew were undermining their constitutions, how to build up and strengthen their vital organs, develop their muscles, and make live, active, red-blooded, forceful MEN of themselves again.

My book **"Promotion and Conservation of Health, Strength and Mental Energy"** will show you how they did it; how YOU can do for yourself what they did for themseves, in a simple, easy, natural way. Send for a copy—IT'S FREE. Enclose three 2c stamps to cover postage and packing and I'll mail it to you at once.

LIONEL STRONGFORT
Physical and Health Specialist
1115 Strongfort Institute. NEWARK, N. J.



MODEL BUILDERS

Blueprints of the following models ½ actual size, 50 cents postpaid in the United States.

Bleriot Racer flies 500 feet
Manhattan Racer flies 2000 ft.
Montauk Flier flies 500 feet

Two sheet blueprint of the Famous HEC Flying Boat; will rise from the water under its own power. $1.00 postpaid. Blueprint of HEC 3 ft. Curtis Biplane 75 cents postpaid. Our supplies are the best and the cheapest. Send for our catalogue "H3."

HEC AEROPLANE CO.
345 East 49th St., - - New York City

POPULARITY FOLLOWS THE
UKULELE

If you play quaint, dreamy Hawaiian music or latest songs on the Ukulele you will be wanted everywhere. We teach by mail 20 simple lessons; give you free a genuine Hawaiian Ukulele, music, everything—no extras. Ask us to send the story of Hawaiian music. You will love it. No obligation—absolutely free.

The Hawaiian Institute of Music
1400 Broadway, Dept. 13K New York

Remarkable Price On Aerial Wire

Pure copper, B. & S. gage No. 12 aerial wire priced at 40c per pound. Immediate shipment. When ordering, do not forget to add enough to cover postage.

A five cent stamp will procure our illustrated catalogue showing many bargains in apparatus for electrical experimenters.

ELECTRICAL SPECIALTY COMPANY
Dept. R—48-50 South Front Street
Columbus, Ohio
Dept. R—128 So. Eleventh Street
Philadelphia, Pa.

You can be quickly cured, if you

STAMMER

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

Benjamin N. Bogue 852 Bogue Building, Indianapolis

OPPORTUNITY AD-LETS

Classified advertising rate two cents a word for each insertion. 10 per cent. discount for 6 issues, 20 per cent. for 12 issues. Name and address must be included at above rate. Advertisements for the December issue must reach us by November 25.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Agents Wanted

Next Saturday you can earn any of the following: a five cup detector, two slide tuning coil, telegraph outfit two stations, variable condenser, 1000-ohm wireless receiver, ground switch, 400 feet of copper-clad aerial wire, high-frequency buzzer, or 8 large aerial insulators, for selling 25 household necessities that go like wildfire because they sell so cheap. Send your order now, but no money, until you have sold them. Write me for any further information. Leonard Beck, 1298 Carroll St., Brooklyn, New York.

Kerosene Gas Burners in Cook Stoves stops use of wood or coal. Patented. Get exclusive territory. The Vapor Gas Burner Co., Desk 2, Columbus, Ohio.

Agents: Sell latest joke novelties. Stamp brings Wholesale Catalogue. Mears, 66, Anderson, Ind.

Business Opportunities

Stamp Names on Key Checks; spare time make as high as $19 a hundred. Send 25c. for sample and Instructions. Returned if required. Elet Keytag Co., Cohoes, N. Y.

$50.00 a Week Evenings. I made it with a small mail order business; continued my regular job daytime. Free booklet tells how. 2c. postage. Albert W. Scott, Cohoes, N. Y.

$5.0 per 100 Paid for Names and Addressees. Particulars free. Victor-King Co., 36 Bromfield St., Boston, Mass.

California Farms for Sale. Write for list. E. R. Waite, Shawnee, Oklahoma.

Auto Accessories

Vulcanize Rubber without heat or tools. Whirlwind seller to every Auto Owner. Further particulars free. Muscatine Agency EE 402, Muscatine, Iowa.

Books

Books. Practical Mechanical, Auto, Aviation, Home Study Books. Easy payments. Send dime "tonight" for catalogue. Amsco, Department G1, Aurora, Illinois.

Laws of Nature every married and engaged person should know, 50c. (no stamps). Central Company, 601 Ninth Ave., New York. Novels, mechanical, women's books. Write for lists.

Bible. Smallest in the world. Size of postage stamp. Over 200 pages of New Testament. 12c. postpaid. Charles Dynes, Winchester, Ind.

Great Rabbit Book, 25c. Raise them. A. A. Leve, Syracuse, N. Y.

What Every Girl Should Know. Clothbound, 50c. What Every Mother Should Know, clothbound, 50c. By Margaret H. Sanger, 104 Fifth Ave., New York City.

Star Amateur Electrician. Pocket size. 12c. Joel Tillberg, Proctor, Vermont.

How to Make Wireless Receiving Apparatus. 100 pages, 90 illustrations. Only strictly modern radio apparata are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered, 25c. postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

How to Make Wireless Sending Apparatus. 100 pages, 88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" than any other book we know of. Paper bound, 25c. postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

Back Numbers R. A. N.— We can furnish copies of the August, September and October issues at 15c. each. Orders filled immediately. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

Novelties

Wonderful Elephant, put pill in mouth, light with match and see trunk come out—Elephant, 2 boxes pills, 25c. postpaid. Stamp gets toy-novelty catalog. Electric Novelty Shop, 2000 Fifth—Charlotte, N. C.

Chemicals

Experimenters: We sell chemical apparatus at low prices. Send for price list. Address David Altman, 225 East 110th St., New York.

Wireless

Wireless Apparatus made to your specifications. Lowest prices. No order too small. Lee Bros. Co., 605 N. Walnut St., Champaign, Ill.

Wireless Sending and Receiving and other electrical apparatus for sale at real bargains. Send stamped and addressed envelope for price list. M. H. Caneday, Taylors Falls, Minn.

Radio Supplies for Amateurs. Complete instruments, parts, raw materials. Tin-foil, 2,500 sq.in. per lb., 35c. Galena, carborundum, silicon, molebynite, 30c. per oz. Bakelite, sheet, 20c. per oz. Contact points, 3-16 dia., with thread 5-16-in., 2c. each. Bakelite knobs, 1½-in. dia., 20c. each. Add Parcel Postage. Everything for the Amateur and Electrician. Ermco Quality. Electric-Radio Mfg. Co., 3247 Germantown Ave., Philadelphia, Pa.

Complete Receiving Sets, $7 and up. With 1,000-ohm receiver, tested mineral; guaranteed. Bulletin for stamp. Jenkins, 923 Purchase St., New Bedford, Mass.

The Audion. Its early history and development, Electron Theory and Trigger Action. Compiled by a Chief Electrician Radio, who was stationed at the Naval Radio School as instructor for two years, written by an old amateur for the amateurs, in words that they can understand. Also blueprint diagrams for hook-ups for Receiving Damped Signals, using both air exhausted and gas bulbs. Receiving undamped signals and regenerative circuits. Two step, Amplifier using same (A) and (B) Batteries for both steps. Wireless Telephony with Power Bulb. Working Blue Prints on how to build a "One to One" transformer for use with Audion Amplifier. All for Two Dollars. Address T. O. McKenzie, 104 Warburton Ave., Yonkers, N. Y.

Boys: Drawings, Wireless Telephone, 50c. Irvin E. Pippin, 1220 Locust St., Mt. Vernon, Ind.

Amateurs, Attention. Loose Couplers of 800-15,000 meters, $4-$20. Our long wave couplers are perfectly adapted for undampt wave reception. Our new system of production makes low prices with maximum of quality possible. If your coupler is not obtained from us, it's your own fault. N. A. Radio Equip. Co., 510 Claremont Parkway, Bronx, N. Y.

Detector Stand, with galena, bakelite base, 75c. Radio Sales Co., 1629 McAllister, San Francisco.

2500 Meter Navy Coupler—Undamped wave coupler and pancake coils, B-Battery cabinet, etc. Send stamp for particulars. Carl H. Rauschenberg, Monongahela, Pa.

Radio Amateurs. We have a large stock of special seamless tubing, 3½-in. dia. x 26-in. long, 25c. 4-in. x 26-in., 35c. 5-in. x 26-in. 45c. 6-in. x 26-in., 55c. 5-in. x 36-in., 65c. 5⅝-in. x 36-in., 70c. Sennett & Co., 512 Court St., Hoboken, N. J.

Radio Head Fones (without cords) 1,000-ohms each. Very sensitive. Double, with nickel-head bands, $2.50. Single, with leather head band, $1.50. Postpaid. These are the high-grade pre-war type Murdock fones. W. Vetter, 111 Chattanooga St., San Francisco, Calif.

High Voltage Storage Batteries for Vacuum Tubes, $4.95! Cheaper than dry cells and last longer. Do You need one? We furnish parts. You assemble them. Nothing complicated—full directions. A very compact and efficient rectifier, 4-cell, to charge above or other batteries—complete parts, $2.85. Above offers limited. Don't wait and be disappointed—order now! Parts for vacuum tube panels, complete panels, switches, switch points our specialty at prices that will agreeably surprise you. Second-hand instruments bought, sold or remodeled. Write us your needs at once and become convinced that we can save you money. Western Wireless Supply Company, 2317 Milwaukee Ave., Chicago, Ill.

Make Spark Gap—Zinc strip 1-16 x ¾ x 7-in. long, 10c., pair, 20c.; Zinc ¼-in. rod 5-in. long, 10c.; Zinc radiators ⅜ x ½-in., 10c., ¾ x ¾-in., 20c. Phospher bronze spring strip, 26, 28, 30 gage, 5 sq. in., 10c. Send stamp, wireless parts price list. Electric Novelty Shop, 2000 5th Ave., Charlotte, N. C.

Song Writers

Song Writers: You cannot afford to miss our proposition. Reference, any bank or first-class sheet music house. Warner C. Williams & Co., Dept. R., Indianapolis, Ind.

Printing

3,000 Two Color Labels, $1. Irvin J. Wolf, Station E, Philadelphia.

250 Bond Letterheads or envelopes, either, $1.25; both, $2.25. Postpaid. B. F. Ball & Co., Dept. 21A, Buckland, Conn.

Stamps and Coins

Six Old American and foreign coins, 25c. Durso, Dept. 50, 25 Mulberry St., New York City.

50 Different Stamps, 3c.; 100 different, 10c. Buckey, 412-B Bowen St., Dayton, Ohio.

Free, 68 all-different stamps. Postage, 3c. Alexander Stamp Co., Thief River Falls, Minn.

Fine Old U. S. Cents, 25c. Large English coin, 10c. Bruce Clemmer, Ferguson, Iowa.

Best One Cents approvals in America. F. P. Hand, 1117 So. 60th St., Philadelphia, Pa.

Have You Seen The Stamp Herald? Finest monthly stamp paper published. Subscription, 50c. a year; 3 months' trial for 10c. Stamp Herald Publishing Co., Dept. E., Indianapolis, Ind.

100 Different Stamps, 12c.; 200, 27c. Michaels, 5600 Prairie, Chicago.

Stamps Free—Large packet, including Brazil, Canada, New York State revenues, etc., for names 2 collectors. Stampcraft, Box 252, Hanford, Calif.

200 All-Different stamps, including Bosnia, Bavaria, China, Gautemala, Bulgaria, Bohemia, Poland, Turkey, etc., and Dime Stamp Album, only one to a customer, all for 25c. Our approval sheets contain Bargains, priced at 1c. to 5c. Net. 150 different U. S. Postage and Civil War Revenues for only 75c. Indiana Stamp Co., Dept. E., Indianapolis, Ind.

Formulas.

Formulas Furnished. Questions Answered, 10c. each. Elbridge F. Ball, Box A147, Buckland, Conn.

Formula of the making of Storage Battery Plates, $1. Postpaid. H. Deckelman, 7118 Nashville Ave., St. Louis, Mo.

Send for free catalogue. Golden Opportunities Typewritten Tested Formulas, Chemical Analysis, Trade Secrets in every line. No printed trash. Satisfaction guaranteed. Industrial Sales Service, 73 Washington, Memphis, Tenn.

Invisible Inks—30 formulas, 15c. Horton P. Jones, Perry, Iowa.

Miscellaneous

The Master Key is the best and most convenient for household use; opens 20 different locks. Sent postpaid on receipt of 10c.; or complete set of three for 25c. Safety Key Holder free. Sharpe Novelty Co., Paterson, N. J.

For Men

Shavine Powder—enough for five razorless shaves, 25c. Durso, Dept. 50, 25 Mulberry St., New York City.

Health

Tobacco Habit Conquered. $1 prepaid. Entirely new. Guaranteed, Harrison, 105 Walker, Evansville, Ind.

Pyorrhea (Rigg's Disease—Bleeding or Swollen Gums). H. E. Kelty, D.D.S., M.D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea. Purifying, healing, preventative. Full month's treatment, $1 postpaid. Or, write for free booklet. Pyorem Mfg. Co., 439 Seventh St., Brooklyn, N. Y.

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., SB, Baltimore, Md.

Exchange

For Sale: Packard wireless transformer, structo outfits, small motors, wireless, electrical, and telephone and telegraph apparatus. Write for descriptions. Lawrence Black, 1835 E St., Lincoln, Nebraska.

Wanted: Audion or audio tron panel set. Must be in first class condition. State price and send full particulars. All letters answered. Leroy Buswell, The Call, San Francisco Cal., City Circulation Dept.

Buy, Sell, Exchange. Wireless and electrical goods. Murdock, Clapp-Eastham, Thordarson, Brandes, etc. Send 10c. stamps for our circulars listing new standard apparatus at less than manufacturers' prices. We have to exchange: Wireless, Electrical, Optical, Cameras, Printing Presses, Typewriters. Large list free. Le Roy Zehrbach, 15 College Ave., Hiram, Ohio.

What Have You to Exchange for Set of ten Hawkins Electrical Guides and one Standard American Electrician, by Swingle; Horstman and Tousley (leather, 640 pages). Want good receiving instruments, audions, loose coupler, rheostats, etc. Also have two Boehm system Clarinets worth eighty-five dollars each. Will sell or exchange for equal value in good transmitting and receiving sets. All the above are as good and look like new. C. O. Williams, Royal Oak, Mich.

Exchange. Harley-Davidson "Road Racer" bicycle, practically brand new, value $62.00. Will exchange for Grebe regenerative set or other reliable appartus. K. Woodruff, Athenia, N. J.

Sale: Two navy couplers, two 2-in. coils, audion cabinet, Blitzen receiving set, 1 KW. condenser, ¼ KW. jar, 3 pair 3 000-ohm fones, fixt condensers, 2 tuners, 6V Edison battery, loads, D. C. motor, 1 KW. transformer and other goods, all new. Bargain prices for stamp. Herbert Walleze, 234 Vine St., Milton Pa.

E. I. 2-Slide Tuning Coil, $1.50. E. I. fixed variable, 75c. ¼-in. wireless spark coil, gap, $3. Transmitting condenser copper plates, $1. Pair Holtzer Cabot phones, 2,000 ohms $11. Honeycomb coil L-1.500, $2.75. Box 90, Radio Amateur News, 233 Fulton St., New York City.

Bargains: In new and used apparatus. Rifles and shotguns taken in exchange; also used apparatus. Vincent Natalish, Jr., 145 West 56th St., New York City.

Exchange—22 Winchester repeating rifle, ¼ H.P. gasoline engine, small stamp collection, line telegraph set, telephone transmitters and receivers, switches, etc. Want audion, condensers or any wireless apparatus or parts. J. D. McMasters, Aberdeen, S. D., R. 1.

For Sale: 500-Watt Bulb, $1.25; 4 keys, new, 45c. each; 1 large sending condenser, $1.00; Western Electric V.T. tube, new, $10. Lee, 605 N. Walnut Street, Champaign, Ill.

Look! Bargains—1 KW. glass plate condenser in rack, $10; 1 KW. oscillation transformer, $4; above never used; 800-meter Navy coupler, $6; 3-cup Chamber's detector, $1; 1-in. spark coil (minus vibrator), $3.25; Ives Miniature Electric Train Set, $4.75; "Rover Boy" and "Putnam Hall" books, 40c. each; all, $7.50. Everything f.o.b. Howard W. Lerch, 159 Cottage St., Lockport, N. Y.

De Forest Oscillion—General Radio Wavemeter, Hot wire ammeter, Graphite Potentiometer, Murdock variable condenser. Fixed condenser, High tension condensers. Electrose aerial insulators, 1,000 feet stranded phosphor bronze aerial wire, Queen 110-ohm plug resistance. Slide wire bridge, telegraph key, Lightning switch, .25 M.F. paper condensers, 150-volt meter, ammeter, Hot wire actions $1 each. Will sell for very little to dispose of. 6-40 storage battery. Horton, 62 Fulton St., Brooklyn, N. Y.

Radio Instruments for Sale. E. E. Rogers, Brainard St., Pittsburgh, Pa.

For Sale, tuner, phones, detector, condenser, variable, good condition. J. Chamflin, 524 Ridge St., Newark, N. J.

¼ H. P. Gasoline Engine, $8; Loose Coupler, $3; Navy Coupler, $6.50; Loading Coil, $1.50; ½-inch Spark Coil, $1.50; Little Hustler Motor, 50c.; Type S S Dynamo, without armature winding or commutator, $2.50. Write—Chiddix, Emory, Va.

Exchange: ½ KW. Worts McKisson closed core transformer in mahogany case, for long wave coils or wire to wind them. Also have large key and other goods. Van Slyck, Ironwood, Mich.

Wanted. Indian cents before 1873. State price. Box 71. Primghar, Iowa.

For Sale: Audion double filament, $5. Socket, 75c. Holster Cabot Phones, 3.000-ohms, $9. De Forest Crystal Detector, $1.25. Loose coupler, $7.00. Buzzer, $1.25. Call or write. Thomas Lynch, 772 Third Ave., New York City.

Storage Battery, 6-volt, 120-amps. New Rotary-gap Motor, 6 large transformer pies, Volt Ammeter, 1 to 30. State wants; send stamp. Ray Keogh, 328 Gosel Ave., Chicago.

Sell or Exchange—8 x 10 Studio Camera, Punching Bag, etc. List for stamp. Want wireless goods, or what have you? Lawrence Johnston, Fairfield, Ill.

Exchange (cont'd.)

Sell: 2-in. Spark Coil, $6. E. I. 6-tube condenser, $1.35. 2 Hoyt meter 30-amp., 30-volts, $3. 1 Motsinger magneto, $3.50. 1 Spark Gap, 90c. 2 Telephones, $3.25. Imp. Torch, 50c. E. I. Rheostat, 35c. A. C. Heyman, 319 9th Ave., So. East, Minneapolis, Minn.

Sale—Half-kilowatt transformer; condenser; rotary gap; parts for another transformer; wire, tinfoil; empire cloth, and many other articles. Jay Pounds, Coldwater, Kan.

For Sale: Navy Bakelite, three-thousand meter coupler and Murdock load; first nine-fifty buys. Edward R. Wendall, Barnard, N. Y.

Wanted Immediately: Several National Automatic Transmitters, also separate sets Morse records, first and second series; high price if good order. George Mason Halcun Radio Co., 437 Market St., San Francisco, Cal.

Revolvers: 32 Iver Johnson solid frame, fair, $2.25. 32 Harrington & Richardson, fair, $2.50. 32 Harrington & Richardson brake open, like new, $8.50. 32 Iver Johnson brake open, like new, $8.50. Iver Johnson 38 calibre blued finish, cylinder and trigger guard nickel, large western grip, new condition, cartridges, $13.75. Natalish, Stockbridge, Mass.

For Sale: Set Hawkins Guides, $7.50. 1-in. spark coil, $3.50. Send stamp for list. J. Nowak, 1419 Franklin Ave., New York City.

Exchange—Brownie No. 2 Camera and eight boy's books, for small wireless set. Charles Miller 914 Druid Hill Ave., Baltimore, Md.

Wanted: Marble's Game Getter and other guns, any make, any condition, modern or old-time. Also wireless instruments. Parties who did not receive reply, write again; mislaid several letters. Lock Box 101, Stockbridge, Mass.

Bargain—4,000-Meter Navy Coupler, dead-end switches, green silk wire, equal to $25 instrument, new, $12.50. Radiator gap, $1.50. Key, heavy contacts, 2.50. Lightning switch, marble base, $2.75. Murdock Antenna switch $2.50. Burgess battery, 1.75. Brandes phones, $5.00. Variometer, unmounted, 1.000-meter, $1.50. Grid condensers mica, unmounted, 25c. each. Write for descriptions; all new apparatus. Want Paragon RA-6. Fred Marco, 1441 Summerdale Ave., Chicago.

Audio Tron—Nickeled Bracket—Rheostat—45-volt B Battery. Price, $7.00. Remit by money order. Positively new. James Quinlan, Herman Keifer Hospital, Detroit, Mich.

Slaughter: 4 500 coupler electro loader 2-slide tuner, detector, switches, $7.50 prepaid (sold separate). Roland Place, 350 Sprague, Fall River, Mass.

Bargain, must sell, Brand New, Omnigraph at $18. Costs $23. K. I. Short Hand Course $4, and White Monoplane blue prints, $1.50. S. B. Ford, Jr., Rockdale, Texas.

For Sale. $25. Short wave regenerative cabinet, $18. De Forest audion cabinet, tubular bulb, without bulb $7., with, $11. Send for list. Corwin Emmons, Sidney, Ohio.

..For Sale, good loose coupler, $7.50, loading coil, $2; crystaloi detector, $2.50; crystal detector, 50c. New A. C. ammeter, 0-5 amps., $10. Will prepay. Send money order. Howard English, 221 Pine St., Shamokin, Pa.

Thordarson 1 KW. Transformer, with condenser $10.00; also have receiving apparatus. Box 473, St. Petersburg, Florida.

Sell or Exchange—One 150-ohm Bunnell Telegraph Relay, nearly new; One 5-ohm Sounder and Key, second-hand, good condition. Ray T. Elliott, Antrim, N. H.

Scenery for Hire

Collapsible Scenery for all plays. Amelia Grain, Philadelphia, Pa.

Song Poems

Song-Writers Manual & Guide Sent Free! Contains valuable instructions and advice. Submit song-poems for examination. We will furnish music, copyright and facilitate publication or sale. Knickerbocker Studios, 311 Gaiety Bldg., New York.

Motion Pictures

Motion Picture Cameras and supplies. General Sales Co., Box 661, Evansville, Ind.

Stammering

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 121 Potomac Bank Bldg., Washington, D. C.

Patent Attorneys

M. H. Loughridge, Patent Attorney. Consulting Engineer. The high-class service of the large manufacturer at modest costs. Designs and manufacturing specifications prepared. 1457 Broadway, New York.

Help Wanted

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis Mo.

Detectives Make Big Money. Travel; be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Ave., Grand Rapids, Mich., Dept. A.

..Secret Service Operatives and Detectives are in demand. Earn big money. Travel everywhere. Fascinating work. Learn this profession by home study. Particulars free. American School of Criminology, Dept. R., Detroit, Mich.

Auctioneers

Auctioneers—Make big money. Free catalogue. Carpenter's Auction School, Kansas City.

Telegraphy

Telegraphy (both Morse and Wireless) and railway accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School. Est. 45 years. Catalog free. Dodges Institute, 25th St., Valparaiso, Ind.

Personal

The Salesman Win$. Thousands of positions open. We teach traveling salesmanship by mail and guarantee offer of position or refund tuition. For interesting particulars, address Kansas Vocational Bureau, Miltonvale, Kan.

Instruction

Learn Chemistry. It pays. trial lesson, 35c. Elbridge F. Ball Box A147. Buckland Conn.

Cornetists—Trombonists: Send for "Free Pointers" Weak Lips—High Tones. Virtuoso Cornet School Buffalo, N. Y.

Gregg Shorthand. Business correspondence and punctuation taught by mail. Low rates. Providence Correspondence School, 44 Franklin St., Providence, R. I.

Become a leader at social gatherings. Mystify, amuse, entertain. Learn mind reading. Complete private instructions, 25c. Circular free. Mysto, 633 Prospect Ave., N. Y.

Office Devices

Addressographs, Multigraphs, Duplicators, Multicolors, Folders, Typewriters, Dictaphones, Check Writers, Sealers. Office Device Company, 222 Y North Wabash, Chicago.

Post Cards

Five Prettiest Women Cards. Hand colored, 25c. Chas. Durso, Dept. 50, 25 Mulberry St., New York City.

For Advertisers

Money? Jacobus Art Ads make small space pay big dividends. Price, $5. Write today. Jacobus Service, 1073 Sanford Ave., Irvington, N. J.

Electrical Supplies and Appliances

Boys—let me know what you need in the electrical line. I can save you money. Bell wire, per lb., 60c.; bells, 42c.; metal push-buttons, 12c.; insulated staples per hundred, 20c.; buzzers, 42c.; 2-cell nickel plated flashlight, $1.20. Postage extra. Geo. M. Wiedeman, 1805 S. Wichita St., Wichita, Kan.

Make-Ur-Own flashlight batteries. Complete outfit, $1. Send for circular. Eagleco, Darien, Conn.

Welding Plants designed for all purposes. Small payment; balance six months. Every mechanic or shop should have one. Ask for our rental plan. R. W. Bermo Company, Omaha, U. S. A.

Motors, Engines and Dynamos

Motors—1-12 and 2 H.P. 110 volts d. c. Krug Realty Co., Cincinnati, Ohio.

Phonographs

Build Your Own Phonograph. We furnish complete material and full instructions. Big profits building and selling. Write for catalogue and free blueprint offer. Choraleon Phonograph Co., 3411 Choraleon Bldg., Elkhart, Ind.

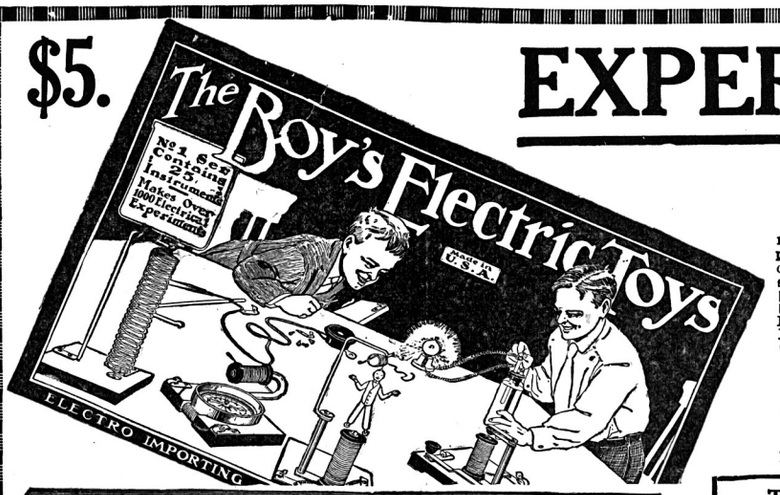
Tricks, Puzzles and Games

250 Magic Tricks and catalog, 10c. Clarence A. Maugans, Anderson, Ind.

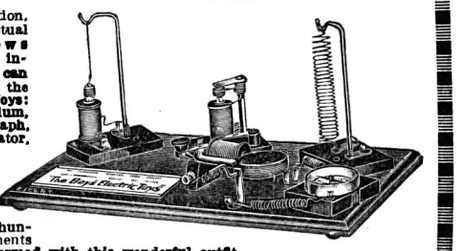
News Correspondents

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

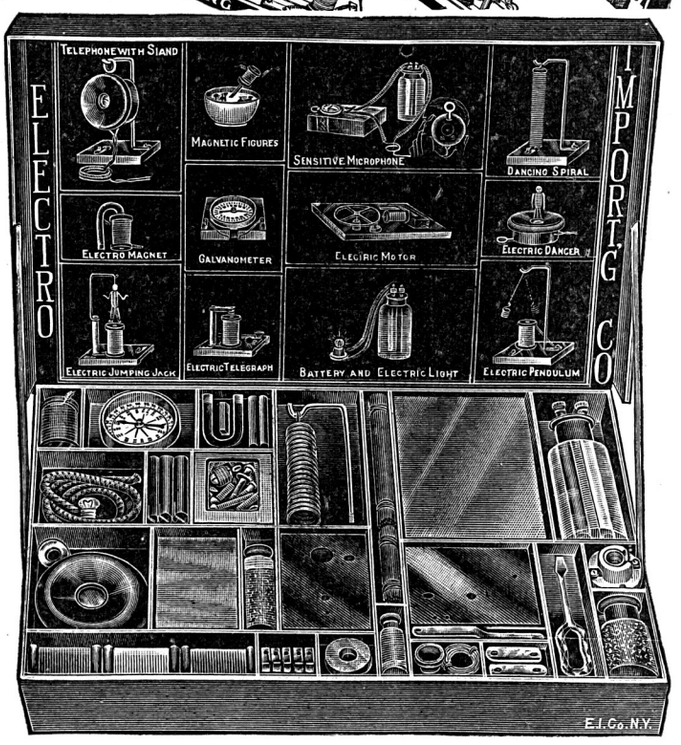
$5. EXPERIMENTERS!



A Sample of What You Can Do With This Outfit



This illustration, made from an actual photograph, shows only a very few instruments that can be made with the Boy's Electric Toys: Electric Pendulum, Electric Telegraph, Current Generator, Electric Dancing Spiral, Galvanometer. Space does not permit us to show the hundreds of experiments that can be performed with this wonderful outfit.



No. EX2002

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs. **$5.00**

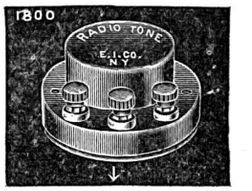
No. EX2002 "The Boy's Electric Toys." outfit as described..... $5.00

IMMEDIATE SHIPMENTS

ELECTRO IMPORTING CO., 231-A Fulton St. NEW YORK

The "Electro" Radiotone

HIGH FREQUENCY SILENT TEST BUZZER



This instrument gives a wonderful high pitched MUSICAL NOTE in the receivers, impossible to obtain with the ordinary test buzzer. The RADIOTONE is built along entirely new lines; it is NOT an ordinary buzzer, reconstructed in some manner. The RADIOTONE has a single fine steel reed vibrating at a remarkably high speed, adjusted to its most efficient frequency at the factory. Hard silver contacts are used to make the instrument last practically forever.

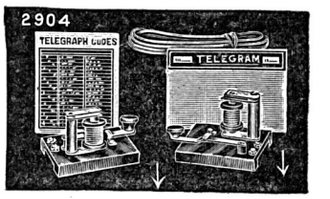
Yes, the RADIOTONE is **SILENT.** In fact, it is so silent that you must place your ear on top of it to hear its beautiful musical note.

You will be astounded at the wonderfully clear, 500 cycle note, sounding sharply in your receivers. **To learn the codes, there is absolutely nothing like it.** With the radiotone, a key and one dry cell and ANY telephone, a fine learner's set is had. Two or more such sets in series will afford no end of pleasure for intercommunication work. **Shipping Weight 1 lb.**

Radiotone as described.....each **$.90**

IMMEDIATE SHIPMENTS

The "Electro" Telegraph



is not a toy, but a practical, honestly built telegraph outfit, which not only sounds but works like the big commercial instruments. By studying the code for 30 days you can become a first-class telegraph operator. Such operators are in big demand now. Outfit consists of TWO complete telegraph instruments each measuring 3½ x 2½ x 2¼. All metal parts are highly nickel plated, including key lever. Note hard rubber knob. Telegraph Code Chart, telegraph blanks and connecting wire comes with set, but no batteries. Outfit works on 2 dry cells (one cell for each instrument). The "Electro" is the ONLY Outfit that works both ways, each station can call; no switches, no extras. Nothing to get out of order. Guaranteed to please you or money back. **Price Complete as illustrated (TWO INSTRUMENTS).. $1.25**

Shipping Weight, 2 lbs.

IMMEDIATE SHIPMENTS

The "Electro" Codophone (*Patents Pending*)

$1.50

What this remarkable instrument is and does.

1999

The "Electro" **Codophone** is positively the only instrument made that will imitate a 500 cycle note exactly as heard in a Wireless receiver. The loud-talking receiver equipped with a horn, talks so loud that **you can hear the sound all over the room,** even if there is a lot of other noise.

THAT'S NOT ALL. By lessening or tightening the receiver cap, a tone from the lowest, softest quality, up to the loudest and highest screaming sound can be had in a few seconds.

FOR INTERCOMMUNICATION. Using two dry cells for each instrument, two **Codophones** when connected with one wire and return ground, can be used for intercommunication between two houses one-half mile apart.

One outfit alone replaces the old-fashioned learner's telegraph set, consisting of key and sounder.

The "Electro" **Codophone** is a handsome, well made instrument, fool proof, and built for hard work. Contacts are of hard silver ⅛ inch in diameter, that will outlast the instrument.

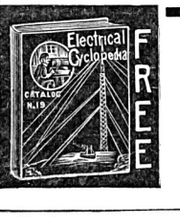
There is also a neat code chart and full directions **enabling any intelligent young man or girl to learn the codes within 30 days,** practising one-half hour a day.

Sizes: 6¾ x 3 x 2⅝". Shipping weight, 2 lbs.

The "Electro" Codophone as described, complete..... **$1.50**

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 228 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 **FREE** coupons for our 160-page **FREE** Wireless Course in 20 lessons. **FREE** Cyclopedia No. 20 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.



ELECTRO IMPORTING COMPANY
231A Fulton St., New York City

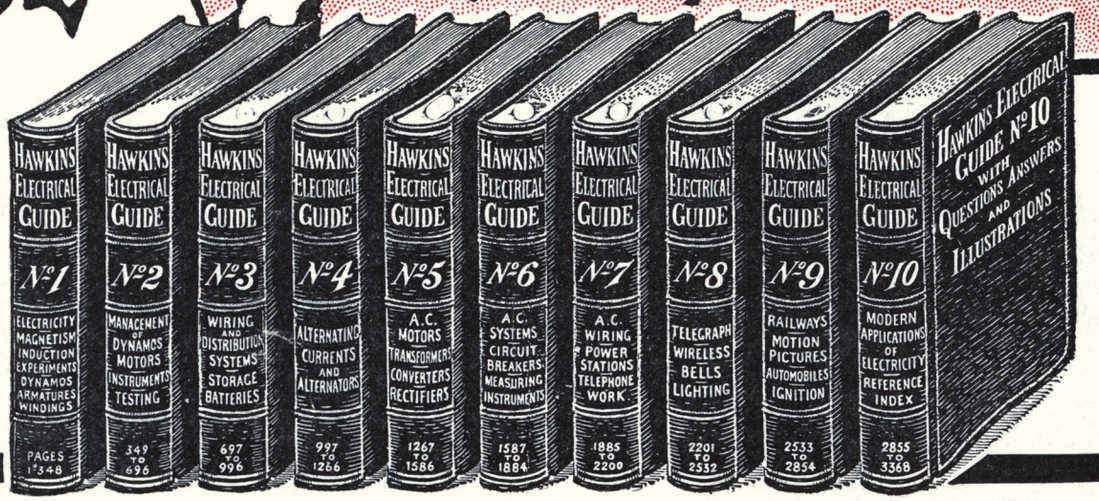
I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 20 as described.

NAME .....

ADDRESS .....

STATE ..... R.A.N. 11-19

Every Electrical Man Wants These Books and we ship them for your inspection FREE


HAWKINS ELECTRICAL GUIDE Nº1
HAWKINS ELECTRICAL GUIDE Nº2
HAWKINS ELECTRICAL GUIDE Nº3
HAWKINS ELECTRICAL GUIDE Nº4
HAWKINS ELECTRICAL GUIDE Nº5
HAWKINS ELECTRICAL GUIDE Nº6
HAWKINS ELECTRICAL GUIDE Nº7
HAWKINS ELECTRICAL GUIDE Nº8
HAWKINS ELECTRICAL GUIDE Nº9
HAWKINS ELECTRICAL GUIDE Nº10 WITH QUESTIONS ANSWERS AND ILLUSTRATIONS

Flexible Covers — Handy Pocket-Size Volumes

10 Volumes — 3500 Pages — 4700 Pictures

$1 Per Volume

$1 Per Month

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly."
C. J. Cornell,
U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble." H. Marshall,
Steamer M & B No. 2,
Walkerville, Ont.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY - USE THE COUPON

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters—wattmeters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

THEO. AUDEL & CO.
72 Fifth Ave.
New York, N. Y.

Please submit me for examination **Hawkins Electrical Guides (price $1 each).** Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature.....

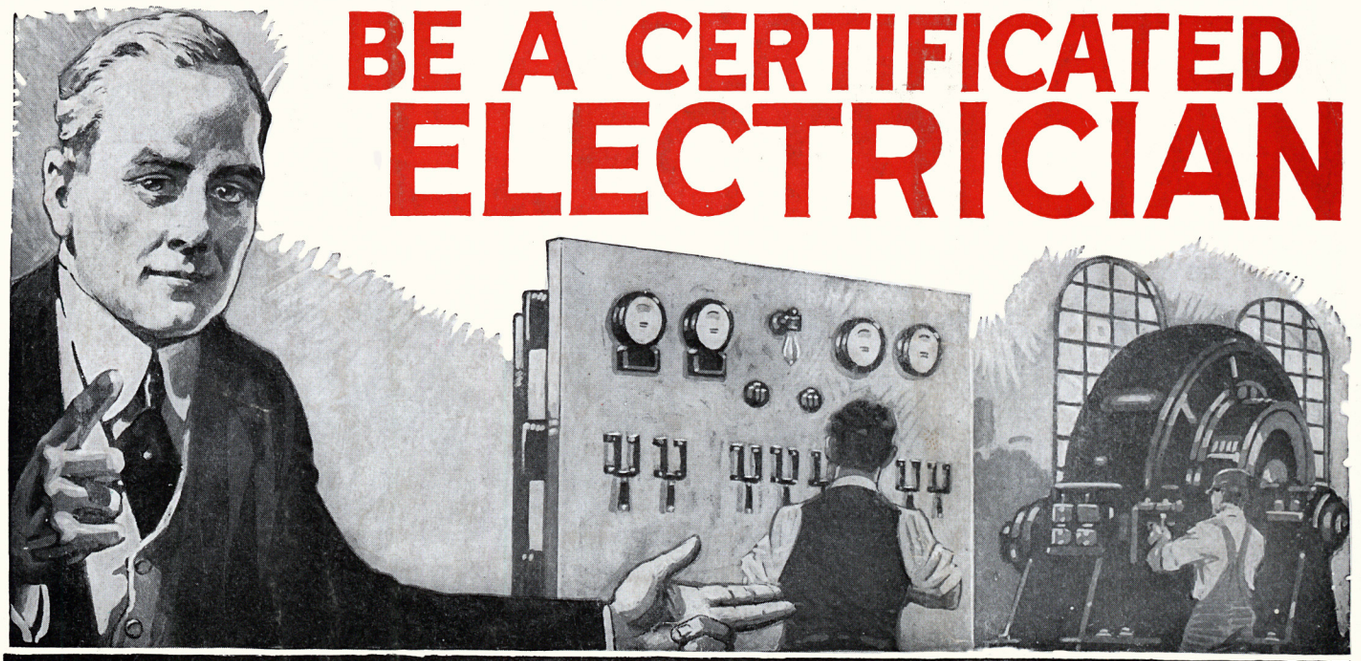
Occupation.....

Employed by.....

Residence.....

Reference..... R. A. N. Nov.

BE A CERTIFICATED ELECTRICIAN



I WILL TRAIN YOU AT HOME

A REAL POSITION LIKE THIS—FOR YOU

The country needs thousands of trained, Certificated Electricians to fill good positions—and at big pay. It's all a matter of knowing how, and I will teach you by up-to-date, modern instruction. You can learn at home, without interfering with your regular work, by my highly successful method of *Home Instruction* in *Practical Electricity*.

Prepare NOW and be ready in a few months to earn your $46 to $100 A WEEK

Send for this Book

My book, "HOW TO BECOME AN EXPERT ELECTRICIAN," has started thousands of young men on the way to splendid success. A new edition of this has just been printed. I want every young man interested in Electricity to have a copy, and will send you one, ABSOLUTELY FREE AND PREPAID. Write me today.

How I Train My Students

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to enable him to get and hold good positions, and to earn big pay. I have trained hundreds of men who are holding splendid electrical jobs.

I give each of my students personal attention and a complete and thorough training. I give him a SPLENDID ELECTRICAL OUTFIT FREE, and much of the training is done by actual work. When my students graduate and receive their Certificate, they are ready for a real position. But *still more,* at any time you wish you can come to our splendidly equipped Electrical Shops for special training. No other school can give you this.

A Real Opportunity for YOU

Wishing is never going to make your dreams come true. You've got to *study*—to *learn*. A man is worth possibly $2 or $3 a day from his neck down—and no more; but there is *no limit* to what he can be worth from his neck up.

A *trained mind* is what gets the big pay. It is this training that you need, and I can train you in a few months. Are you ambitious to make a real success—then send me the coupon—today.

Electrical Outfit FREE

To every student who answers this ad I am giving a Splendid Electrical Outfit of standard size Electrical Tools, Instruments, Materials, etc., *absolutely free.* Furthermore, to every Electrical Student I give a truly *valuable* surprise that I cannot explain here.

Free Employment Service

I am continually receiving requests from employers to send them trained Electrical men. I assist my students to secure good positions. I keep in touch with them for years, helping and advising them in every possible way.

Write Now—Don't Delay

Delay never got you anything. Action is what counts. Get started—and get started now. Write me, or send me the coupon, right NOW.

L. L. COOKE, *Chief Engineer*
CHICAGO ENGINEERING WORKS
441 CASS ST. Dept. 410-X CHICAGO

USE THIS "FREE OUTFIT" COUPON

CHIEF ENG. COOKE, Dept. 410-X 441 Cass St., Chicago, Ill.

Sir: Send at once—fully prepaid and entirely free—complete particulars of your great offer for this month.

Name .....

Address .....

City .....

State .....

YOU CAN DO IT